PEACE FOREST DISTRICT ARCHAEOLOGICAL OVERVIEW ASSESSMENT

(Heritage Inspection Permit #2008-0333)

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ARCHAEOLOGICAL OVERVIEW ASSESSMENT

HERITAGE INSPECTION PERMIT #2008-0333

Prepared for:

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MINISTRY OF FORESTS AND RANGE
Peace-Liard Business Area
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MANAGEMENT SUMMARY

Between 2007 and 2010, Arcas Consulting Archeologists Ltd. (now AMEC Earth & Environmental, Archaeology and Cultural Heritage Resources Group), in association with Millennia Research Limited with technical assistance from Timberline Natural Resource Group, conducted an Archaeological Overview Assessment (AOA) of the Peace Forest District. This project was undertaken at the request of the BC Timber Sales, Ministry of Forests and Range – Peace-Liard Timber Sales Office, Dawson Creek, BC. Funding was provided by the Forest Investment Account – Provincial of British Columbia. This project was conducted with the assistance and direction of BC Timber Sales (Contract Number AA08TDC001 YR 1). Under the terms of the contract the Province of British Columbia owns the copyright to the report and model.

The primary goal of this AOA was to provide BC Timber Sales (BSTS), licensees, First Nations, and other resource managers within the Peace Forest District with a Geographic Information System (GIS) model which would assist with the effective protection and management of archaeological resources within the Peace Forest District. This AOA used a model created in a computer-based GIS to predict the relative archaeological potential (sensitivity) of the landscape within the Peace Forest District.

This report presents an overview of the objectives, approach, methodology, and results of the AOA. It is intended to accompany digital (on separate hard disk and DVD-ROM) and paper maps provided to BC Timber Sales. All management decisions based on these maps should be made in reference to the recommendations found in this report. A number of Technical Appendices to this report are presented which provide additional technical details regarding the methodology, results, and recommendations of the study.

The AOA will benefit all groups with an interest in the protection and appropriate management of archaeological resources in the study area, including First Nations, BCTS, licencees, the Archaeology Branch and other land managers for the area. The digital and paper maps produced by this study can be used to assess the archaeological sensitivity of the landscape. This assessment will assist in determining the appropriate management actions to be taken in order to avoid conflicts with archaeological sites. The AOA process provides all interested parties with the information necessary for planning and monitoring archaeological resource management activities in the Peace Forest District.

This AOA is concerned only with the archaeological (physical) evidence for past human activity, and does not address traditional use activities or other concerns. It was not the intent of this AOA to document First Nations interests in the land, and the modelling of archaeological potential was conducted without prejudice to aboriginal rights or title. This AOA **is not** a substitute for First Nations consultation; First Nations consultation is recommended as part of all archaeological management decisions. The participation of First Nations in this AOA does not necessarily mean that these First Nations endorse or agree with the process or results of this AOA. The model of archaeological potential used in this study is based on current knowledge and assumptions, and should be subject to ongoing revision as additional information becomes available.

Modelling was based on British Columbia TRIM (Terrain Resources Information Management) mapping, including a Digital Elevation Model (DEM) and line and polygon features such as rivers

and lakes. The DEM, in its raw data state, consists of mass elevation points covering the landscape at a spacing of 50 to 100 m apart, as well as breaklines which are intended to define major features such as sharp and rounded breaks in slope (for example, cliffs and ridge-tops), streams, roads, and other water features. DEM processing consists of interpolating these point and line features to create a continuous raster grid, with cells containing elevation values.

Custom AML (Arc Macro Language) scripts were developed by Millennia Research Limited and Timberline Natural Resource Group during previous modelling projects. These consist of a series of moving windows which analyze the input DEM and output several different variables. These variables can be combined to identify locations that are the tops of hills, knolls, ridges, terraces, etc. The count variable can identify hilltops and ridges, but does not discriminate between large and small, or even barely discernable features, while the positive value identifies the magnitude of the landform. The final model was composed of the original terrain model, the revised terrain model, and the traditional use study (TUS layers).

Preliminary results showing that the terrain model worked well in more varied terrain, but poorly where terrain variation was limited, were confirmed by the ground-truthing. Therefore, the study area was broken up into two regions. This was based on the elevation range over a window 500 m on a side. Region 1 consists of areas where the elevation range was greater than 75 m within this 500 m window, while Region 2 consists of areas where the elevation range was less than 75 m. These regions were analyzed separately to determine final model performance in each. Model performance was measured using a couple of different methods. These methods include analysis of the ground-truthing data collected, comparing ground-truthing data to the model, as well as analysis of the number of recorded archaeological sites in the forest district that are captured by the model.

Current models for the Northeast emphasize landforms as the most important variable for predicting the location of archaeological sites. Our modeling approach and technique gives users the ability to identify with great precision almost all of the landforms predicted to high potential. What is missing in a large number of areas is the data needed for this approach. In particular we lack high-resolution DEM that we can use to obtain greater precision for our archaeological models. LiDAR provides the ideal data source for improved modeling in the NE with its 1-2 m spacing of elevation data points accurate to a few centimetres relative to their neighbours. This is not to say that the model based on TRIM is of no use; in fact, it fully meets provincial standards set by the Archaeology Branch for a large part of the area and is still useful in the remainder. However, qualifications and guidance for use of the TRIM based model follow.

Users of the model should first determine which region designation applies to their area of study. The TRIM model is divided into two regions, based on the degree to which the model meets government modeling standards. In Region 1, with its higher relief, the model meets standards both for capture of a suitably large percentage of the known sites, and for having an efficient Kvamme's Gain. In these areas, about 80% of the known sites are within the modeled area, and the model can be relied upon to provide strong support for decisions on whether further archaeological assessments are necessary. Even in these areas, however, the model should not be used in exclusion of other data, including for example traditional use information from First Nations, high-resolution orthophotos, surficial geology mapping, or prior expert knowledge of the specific locale. The model should also be used as a guide rather than a simple black-and-white decision-maker. For instance, if the model is showing long, but discontinuous, strips along a natural linear feature, such as a terrace edge, additional high potential may occur in the gaps. It may be that the terrace edge in actuality continues but a wobble in the linear feature results in the TRIM DEM having attributes that are just below model selection thresholds. A development that applies only to the 'gap' in the model should examine other data to ensure that the high potential landform is, in fact, absent.

In Region 2, low relief predominates and most sites are associated with microtopographic landforms too small for TRIM data to capture. The model meets Kvamme's Gain standards for efficiency – where it predicts sites, they are likely to be present – but it misses the majority of known sites that occur on microtopographic landforms that are essentially scattered randomly across the landscape. In Region 2, **the model should be used with caution,** as it can potentially miss areas with high potential. If the model suggests potential, then there is a strong likelihood of conflicts with archaeological resources. However, other information, such as those described in the preceding paragraph, should be used to make the decision regarding additional archaeological study in the areas where no potential is indicated.

ACKNOWLEDGEMENTS

A project of this scope requires the assistance and support of a large number of people. Many individuals helped with this AOA, and all deserve credit. The AOA benefitted greatly from the experience and knowledge of a diverse group of people representing First Nations, government, and industry interests. In particular, Arcas Consulting Archeologists Ltd. (now part of AMEC Earth & Environmental) and Millennia Research Limited would like to thank the following for providing input and direction, support and involvement in thorough out the duration of the project.

We would like to thank the Forest Investment Account – Ministry of Forests and Range for funding the archaeological overview assessment discussed in this report. We also wish to acknowledge the great support of BC Timber Sales – Peace Liard. In particular, we want to thank Frank D. McAllister, Planning Officer, and Bob Phipps, Planning Forester, for their assistance during all stages of this project. We also wish to thank Carole Savage, Highwood Forest Management, for her integral role as consultant for Forest Investment Account and BC Timber Sales, pertaining to financial matters and management support throughout the course of the project.

We also extend our thanks to Alec Chingee, McLeod Lake Indian Band Land Office Manager, for implementing and coordinating traditional use information aspects of the AOA with the Band. In addition; Verne Solonas, former Land Office Manager of the McLeod Lake Indian Band, served as coordinator during project initialization and as a consultant during the completion of the project including arranging elder interviews in support of the AOA. We also wish to thank Lyle Letendre, of the Kelly Lake Metis Settlement Society, who provided input to the study by supplying relevant TUS data; Norma Pyle, Lands Manager, Blueberry River First Nation, and Roslyn Pokiak, Lands Manager, Halfway River First Nation also assisted in providing field assistants for the project.

The authors also wishes to express their sincere thanks to Blair Yahey and Trevor Adekat (Blueberry River First Nation), Larry Davis, Ruby Apsassin and Brian Acko (Doig River First Nation), Sand Field (Halfway River First Nation), Einar Dautel (Kelly Lake Métis Settlement Society), Vincent Chingee and Andrea Jackson (McLeod Lake Indian Band), and Ryan Desjarlais (West Moberly First Nation), for their assistance during the fieldwork component of the study.

Thanks are also extended to the McLeod Lake Indian Band TUS working group: Jessica Erickson (who conducted the interviews), Josee Tylee, Ivor Smaaslet, Zepheria Isadore, Michael Solonas, Eugene Isadore, Doreen Isadore, Max Tylee, Andrew Solonas and Harry Chngee (interviewed by Sarah Gamble). The Map Review session consisted of Verne Solonas (arrangement and liaison), Geraldine Solonas (elder's coordinator for map review session), Lawrence Solonas, Agnes Solonas, Josee Tylee, Ivor Smaaslet, Zepheria Isadore, and Georgina Chingee.

We also thank Ian Smith and Brian J. Calder of Timberline Natural Resource Group Ltd. for their assistance with various aspects of the GIS analysis, computer number crunching, and hard copy production pertaining to this study.

In addition, we would like to thank Dave Hutchcroft and Eric Forgeng, Archaeologists at the Permitting and Assessment Section, Archaeology Branch, Ministry of Tourism, Culture and the Arts in Victoria, for their assistance with various aspects pertaining to the Heritage Inspection Permit. In addition, we wish to thank Doug Glaum, Manager, Archaeology Site Inventory Section, Archaeology Branch, for his extremely insightful review and input during various stages of the AOA.

The professional opinions expressed in this report are those of Arcas and Millennia, and not necessarily those of any individuals, groups, or institutions involved in the study. Arcas Consulting Archeologists Ltd. and Millennia Research Limited are solely responsible for the content of this report, including any errors, omissions, or shortcomings.

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1.0 INTRODUCTION

Between 2007 and 2010, Arcas Consulting Archeologists Ltd. (now AMEC Earth & Environmental, Archaeology and Cultural Heritage Resources Group), in association with Millennia Research Limited with technical assistance from Timberline Natural Resource Group, conducted an Archaeological Overview Assessment (AOA) of the Peace Forest District (Figure 1). This project was undertaken at the request of the BC Timber Sales, Ministry of Forests and Range – Peace-Liard Timber Sales Office, Dawson Creek, BC. Funding was provided by the Forest Investment Account – Provincial of British Columbia. This project was conducted with the assistance and direction of BC Timber Sales (Contract Number AA08TDC001 YR 1). Under the terms of the contract the Province of British Columbia owns the copyright to the report and model.

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1.1 Scope and Limitations

This AOA is concerned with archaeological sites. An archaeological site is a geographic place which contains physical evidence of past human activities which can be best studied using archaeological methods of investigation. Different kinds of physical evidence (also known as archaeological remains or resources) can be present in various combinations at archaeological sites. Examples of archaeological resources are cooking pits, storage pits, artifact scatters, trails, habitation remains, human burials, rock art, and bark-stripped trees. Although an archaeological site is restricted to the location containing physical evidence, it is related to the traditional use of the area around a site, and this use often is important for understanding why a site is present and the purpose of the site.

A traditional use site is a geographic place where aboriginal people undertook one or more traditional activities. Some traditional use sites contain physical evidence of those activities, and are considered to be archaeological sites as well as traditional use sites. However, some traditional activities such as berry picking, medicine collecting and spiritual practices leave little or no physical evidence. Traditional use studies, which rely on interviews and archival research, are intended to investigate traditional use sites which do not contain archaeological evidence.

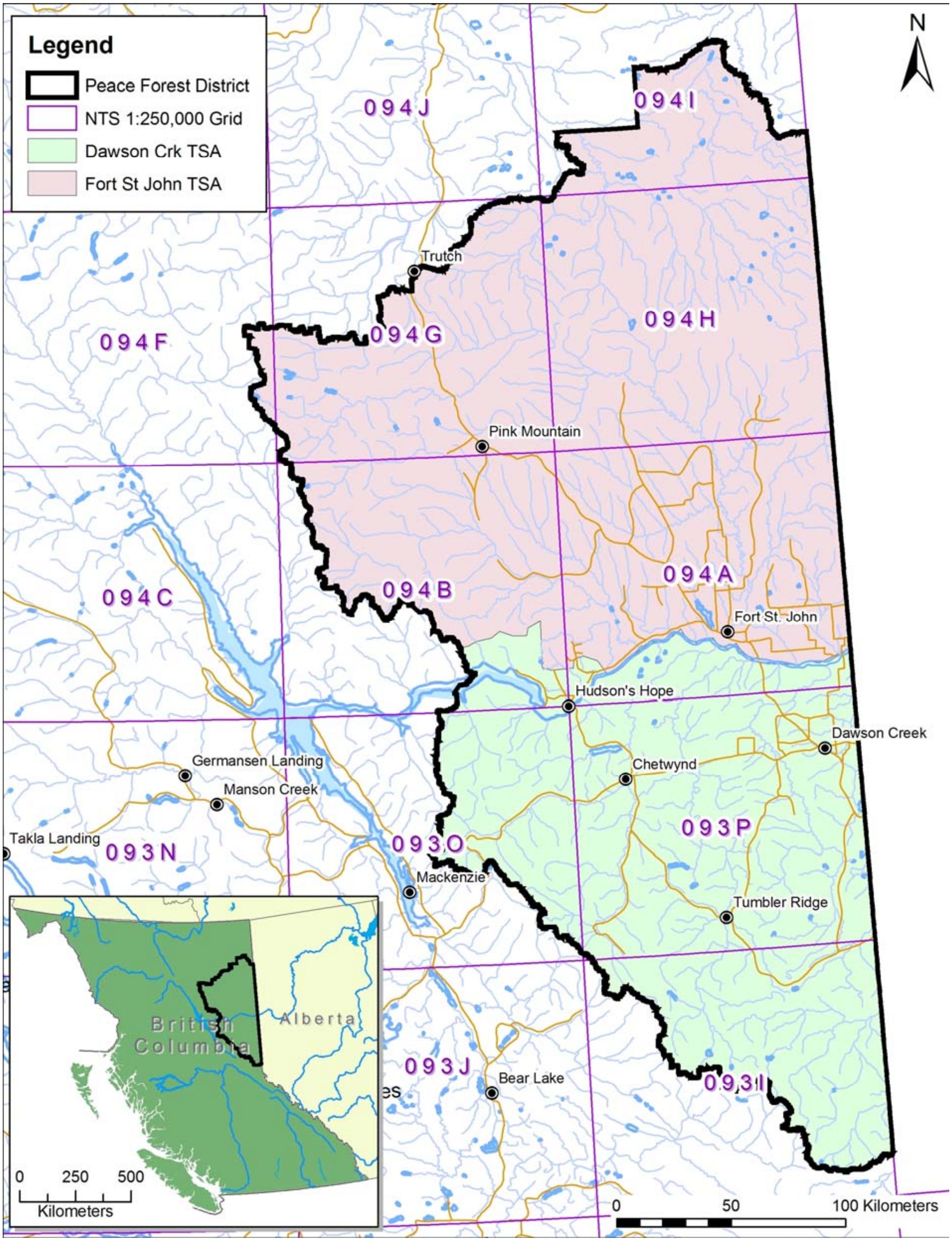


Figure 1. Peace Forest District Archaeological Overview Assessment Study Area.

The Blueberry River First Nation, McLeod Lake Indian Band, Halfway River First Nation, Kelly Lake Métis Settlement Society, and other First Nations with interests in the Peace Forest District, participated in or were consulted as part of this study. Not all First Nations within the Peace Forest District took part in the study and the involvement of those First Nations would took part does not necessarily mean that these First Nations endorse or agree with the process or the results of this AOA.

1.2 Objectives, Application, and Products

The AOA will benefit all groups with an interest in the protection and appropriate management of archaeological resources in the study area, including First Nations, BCTS, licencees, the Archaeology Branch and other land managers for the area. The digital and paper maps produced by this study can be used to assess the archaeological sensitivity of the landscape. This assessment will assist in determining the appropriate management actions to be taken in order to avoid conflicts with archaeological sites. The AOA process provides all interested parties with the information necessary for planning and monitoring archaeological resource management activities in the Peace Forest District.

Primary Objectives:

- to classify the lands of the Peace Forest District into two classes of relative archaeological potential;
- to provide the BC Timber Sales with recommendations for each class of potential which ensure appropriate archaeological management in forestry planning, and;
- to provide accurate digital GIS data showing the locations of recorded sites, aboriginal and historic trail routes.

Applications and Benefits:

- identifying areas of highest archaeological sensitivity and concern;
- assisting users in making appropriate land use decisions;
- allowing for efficient and effective archaeological management in forestry planning;
- standardizing appropriate levels of archaeological work in forestry developments;
- identifying recorded archaeological sites so that impacts can be avoided;
- providing the information necessary to monitor archaeological management actions;
- identifying next steps in model refinement and enhancement.

Products:

- digital (1:20,000 & 1:50,000 base scale) and paper maps (1:50,000 scale) of the study area showing the extent of the high potential lands;
- .mxd files and AOA poly shapefiles loaded on to the BCTS system (i.e. Peaches drive);
- All deliverables (.mxd files, AOA shapefiles, PDFs, reports, Google™ Earth application, etc.) on the portable hard drive for distribution to other licensees as well as serving as a repository/backup for the data;
- all deliverables burned to DVDs (with the exception of the .mxd files) for subsequent distribution to each of the First Nations;
- recommendations for addressing archaeological and digital data gaps and model limitations;
- recommend management actions for high archaeological potential in the two Regions.

BCTS, First Nations, licencees, and the Archaeology Branch have full access to the digital maps produced by this overview.

The report is divided into eight chapters in addition to references cited and eight appendices which provide supporting documentation for the report. The first chapter introduces the study; the second chapter provides a general introduction to archaeological site management; Chapter 3 provides general background information on environment, ethnography and archaeology for the Peace Forest District; Chapter 4 discusses potential development activities in the Peace Forest District and potential uses of the model. The methodology for the development of the model is provided in Chapter 7 and includes discussion of Heritage Inspection Permit #29908-0333, incorporation of the traditional use information, image classification, and the final model creation. Documentary and consultation results are summarized in Chapter 6. Modelling results are presented in Chapter 7 with recommendations provided in Chapter 8.

1.3 Study Area

The Peace Forest District (Figure 1) is approximately (~ 6.95 million hectares) and consists of two Timber Supply Areas (TSA), the Dawson Creek TSA (~ 2.28 million hectares) and the Fort St. John TSA (~ 4.67 million hectares). Major communities in the District are the City of Dawson Creek, the City of Fort. St. John, the District of Chetwynd, the District of Hudson's Hope, the District of Tumbler Ridge, the District of Taylor and the Village of Pouce Coupe.

The Forest District is bounded to the south and southwest by the Price George Forest District, to the west by the Mackenzie Forest District, to the north by the Fort Nelson Forest District and the east by the British Columbia – Alberta border. Additional information on the environment and First Nations peoples is provided in Section 3.0.

1.4 Study Team

This project was a joint venture between Arcas Consulting Archeologists Ltd. (now AMEC Earth & Environmental) and Millennia Research Limited. Technical support was provided by Timberline Natural Resource Group.

- Arcas Consulting Archeologists Ltd. was responsible for project management, liaison, background research, assisting with model development and computerized assessment of archaeological potential, reviewing the application of the model, and reporting;
- Millennia Research Limited was responsible for developing the model, acquiring, translating, and classifying all digital data, application and review of the model, recommendations, producing digital outputs and reporting;
- Timberline Natural Resource Group was responsible for computer processor applications for translating and classifying all digital data, and producing paper outputs;
- Blueberry River First Nation undertook community research, and anecdotal site and trail information gathering, and assisting with field assessment of the implementation of the model;
- Kelly Lake Métis Settlement Society undertook community research, and anecdotal site and trail information gathering, and assisting with field assessment of the implementation of the model;
- McLeod Lake Indian Band undertook community research, and anecdotal site and trail information gathering, and assisting with field assessment of the implementation of the model;
- Carole Savage of Highland Forest Management was responsible for contractual implementation and financial oversight on behalf of the Forest Investment Account;
- Frank D. McAllister, Planning Officer and Bob Phipps, Planning Forester of BC Timber Sales, Ministry of Forests and Range – Peace Liard Timber Sales Office, Dawson Creek served as Client representation.

2.0 ARCHAEOLOGICAL SITE MANAGEMENT

2.1 Definitions

This AOA is concerned with archaeological sites. An **archaeological site** is a geographical place which contains physical evidence of past human activities which can be best studied using archaeological methods of investigation (e.g., survey, excavation, data analysis). Different kinds of physical evidence (also known as archaeological remains or resources) can be present in various combinations at archaeological sites. Examples of archaeological resources are artifact scatters, cooking pits, storage pits, trails, human burials, fish weirs, aboriginal rock paintings (pictographs), and bark-stripped trees. Although an archaeological site is restricted to the location containing physical evidence, it is related to the traditional use of the area around a site which often is important for understanding why a site is present and the purpose of the site.

A **traditional use site** is a geographical place where aboriginal people undertook one or more traditional activities. Some traditional use sites contain physical evidence of those activities, and are considered to be archaeological sites as well as traditional use sites. However, many traditional activities such as berry picking, medicine collecting and spiritual practices leave little or no physical evidence, and therefore cannot be identified and studied using archaeological methods of investigation. Traditional use studies, which rely on interviews and archival research, are intended to investigate traditional use sites which do not contain archaeological evidence.

This AOA is concerned only with the archaeological (physical) evidence for past human activity, and does not address traditional use activities or other concerns. It was not the intent of this AOA to document First Nations interests in the land, and the modelling of archaeological potential was conducted without prejudice to aboriginal rights or title. This AOA is not a substitute for First Nations consultation; First Nations consultation is recommended as part of all archaeological management decisions. The participation of First Nations in this AOA does not necessarily mean that these First Nations endorse or agree with the process or results of this AOA. The model of archaeological potential used in this study is based on current knowledge and assumptions, and should be subject to ongoing revision as additional information becomes available.

A number of technical terms are used throughout this report. Some of the more important of these terms are defined below. Additional terms are defined in the text.

- *Archaeology* is the study of past cultures through the examination of material remains and physical evidence of past activities.
- *Ethnography* is the description of the culture of particular social groups, based on aboriginal testimony, participant observation, and written records.
- *History* is the study of the human past through the examination of written and oral records.
- *Traditional activities* are those which were practised by aboriginal people at the time of contact with European culture, and which may still be practised today.

- *Traditional use sites* are geographic places where traditional aboriginal activities took place.
- *Archaeological sites* are geographic places which contain physical evidence of past traditional activities, such as cultural features and cultural materials.
- *Cultural features and cultural materials* are the physical remains found at archaeological sites. Cultural features are archaeological remains which are not portable and cannot be removed from the site context without damaging them, such as hearths, depressions, modified trees, rock art, and structures. Cultural materials are archaeological remains which can be removed from the site context without damaging them, such as stone artifacts and flakes, bone, and fire altered rock.
- *Archaeological site potential* is the relative potential of the landscape to be favourable to the traditional land use activities resulting in the formation of archaeological sites. For example, high potential areas are the most favourable for activities which result in archaeological remains, and therefore the highest probability of finding an archaeological site will occur in these areas.

2.2 Responsibilities for Archaeological Management in the Forest Industry

Management of impacts to protected archaeological sites is a legislated requirement in British Columbia. The forest industry has the obligation to avoid or manage impacts to archaeological sites resulting from forestry operations. Like other industries, the forest industry must meet the requirements for protection and management of impacts to protected archaeological sites under the *Heritage Conservation Act*. In addition, the forest industry has obligations for the protection and management of impacts to cultural heritage resources under the *Forest Act* and *Forest and Range Practices Act*. The term "cultural heritage resources" applies to a large spectrum of heritage resources that is defined in the *Forest Act* as "an object, a site or the location of a traditional societal practice that is of historical, cultural or archaeological significance to British Columbia, a community or an aboriginal people." Under the *Forest and Range Practices Act* Regulations, objectives set by government for cultural heritage resources are to conserve, or, if necessary, protect cultural heritage resources that are: (a) the focus of a traditional use by an aboriginal people that is of continuing importance to that people, and (b) not regulated under the *Heritage Conservation Act*.

2.3 Legislation and Administration

Archaeological sites in British Columbia are protected by the *Heritage Conservation Act*. This *Act* confers automatic protection upon all archaeological sites that pre-date 1846, or undated sites that could pre-date 1846, regardless of whether they are recorded in the Provincial Heritage Register Database. All burials and rock art sites of "historical or archaeological value" and all heritage wrecks (ship or aircraft) also are automatically protected under the *Heritage Conservation Act* regardless of age. Post-1846 archaeological sites not automatically protected under the *Heritage Conservation Act* can be protected by Ministerial Order or Designation by an Order-in-Council, but most sites younger than 1846 are not protected in British Columbia. Similarly, paleontological sites are not protected by provincial legislation.

The *Heritage Conservation Act* and the issuance of permits under the *Act* are administered by the Archaeology Branch of the Ministry of Tourism, Sports and the Arts.

2.4 Archaeological Management and AOA Mapping

The mutual roles and responsibilities of the Ministry of Tourism, Culture and the Arts and the Ministry of Forests and Range in the integration of cultural heritage resources in forestry planning and operations are defined in a *Protocol Agreement with the Ministry of Forests* (1996) between the two ministries. The requirements and procedures for archaeological studies undertaken for proposed development projects including forestry developments such as harvesting blocks, access roads, log dumps, etc., are described in the *British Columbia Archaeological Impact Assessment Guidelines* (Archaeology Branch 1998). In addition, the Archaeology Branch has developed, based on these *Guidelines*, the *British Columbia Archaeological Resource Management Handbook for Foresters* (Archaeology Branch 2007) to aid in planning for and avoiding or managing impacts to protected archaeological sites. The planning phase of archaeological management in forestry determines where archaeological field studies are required which, in turn, will identify and assess archaeological resources and result in the archaeological management decisions.

One method used to identify operational areas with the potential to contain protected but unrecorded archaeological is the archaeological overview assessment (AOA) mapping (*Handbook*, page 6). The focus of the AOA is the identification of lands in an area that might contain unrecorded archaeological sites, and the identification of appropriate actions for any proposed developments in the future. An AOA provides information (including maps) on archaeological site potential and distribution in the study area. Existing knowledge about the location, nature and distribution of archaeological sites in an area, and knowledge about early First Nations land use in the area is used to build a model of where archaeological sites should be located. The model is then used to identify similar areas on the landscape, and map the study area into areas of high and low potential to contain archaeological sites. Proposed specific developments can then be assessed against the mapped landscape to determine if archaeological field studies are required. This mapping also can be used to find locations with low archaeological potential for the placement of new developments, thereby reducing the likelihood of impacts to unknown archaeological sites.

The current AOA is a planning study initiated by the BC Timber Sales of the Ministry of Forests and Range and the forest licensees of the Peace Forest District to better protect and manage the archaeological resources of the Peace Forest District. The AOA is intended to benefit all groups with an interest in the protection and appropriate management of archaeological resources in the study area, including First Nations, Ministry of Forests and Range, licensees, and the Archaeology Branch.

3.0 STUDY AREA

3.1 Environmental Background

There is a vast diversity of flora and fauna within the Peace Forest District. Low lying muskeg creates excellent moose habitat, while steep, rocky slopes provide stomping grounds for mountain goats. These different environments have been classified by the Ministry of Forests Research Branch into separate and distinct Biogeoclimatic Zones. The study area contains four different biogeoclimatic zones which are discussed here in further detail.

3.1.1 Biogeoclimatic Zones

The Boreal White and Black Spruce (BWBS) biogeoclimatic zone is characterized by cold winters with a warm short summer (Alldritt-McDowell 1998a). BWBS forests cover the Alberta plateau and lower elevation foothills and valleys north and east of the Rocky Mountains. Two different overlapping ecosystems comprise most of the BWBS zone: upland forests and low-lying muskeg. Upland forests contain mixed canopies of white spruce, trembling aspen and lodgepole pine with occasional black spruce. Black spruce and tamarack bogs characterize level muskeg or lowland areas. These areas are generally poorly drained and may have expanses of standing water (Alldritt-McDowell 1998a).

The Engelmann Spruce-Subalpine Fir (ESSF) biogeoclimatic zone occupies the highest forested elevations in British Columbia comprised of forest, parkland and herb meadows. This zone is noted for a short, cool growing season (Alldritt-McDowell 1998b). The ESSF zone is characterized by rugged slopes and steep water-carved valleys. It extends to the rolling foothills and high elevation areas of the interior plateau. Forest cover within the ESSF is characterized by Engelmann spruce and subalpine fir in the lower and middle elevations, with parklands comprised of fir trees mixed with areas of heath, meadow and grassland (Alldritt-McDowell 1998b)

In the Spruce-Willow-Birch (SWB) zone, cold winters with short cool summers create a harsh environment where only a limited forest cover will grow. It is found in mountainous terrain in the northern portion of British Columbia and extends up into the territories. Conifers are the dominant tree type, including white spruce and occasional pine at lower elevations and subalpine fir at higher elevations. Scrub birch and willow are common and occupy the upper elevations in open woodlands (Alldritt-McDowell 1998c).

The Boreal Altai Fescue Alpine (BAFA) biogeoclimatic zone is found in the highest elevations of BC. It has a severe climate with the mean average temperatures ranging from -4˚ to 0˚ C. Rock, snow and ice create the prevailing landscape in this zone, although alpine tundra with shallow soils comprises a large portion of the ground cover in this zone within the project area. Stunted evergreen shrubs known as “krummholtz” and dwarf birch and willow are the only trees in this area, found at lower elevations in the zone. Higher elevations are typically vegetated by grasses, sedges and lichens, with alpine meadows boasting a rich display of colour mid-summer with flowered plants such as forget me not, arctic lupine, subalpine daisy, Indian paintbrush and buttercup (MacKenzie 2006).

3.1.2 The Ecoprovinces of the Peace Forest District

The Peace Forest District is comprised of widely varied terrain and associated environments, ranging from high mountain valleys in the south and west to upland plateaus and lowlands in the north and east. The study area is broken down into five distinct ecoprovinces, with seven ecoregions and 14 different ecosections within the ecoprovinces. The ecoprovinces, ecoregions and their sub sections are discussed below.

Sub-Boreal Interior Ecoprovince

The southwestern portion of the Peace Forest District is represented by the Sub-Boreal Interior ecoprovince. This area is characterized by mountains and foothills and includes the watersheds of the Pine, Halfway, Wapiti and Peace Rivers. The area has a consistent prevailing wind from the west bringing air from the coast, although after crossing the Coast Mountain Range, the majority of the moisture has left the air, leaving this portion of the study area in rain shadow.

The climate of the Sub-Boreal Interior ecoprovince is generally cool and dry. The lower elevations of the ecoprovince fall primarily within the BWBS biogeoclimatic zone. The middle slopes of the mountains as well as the tops of the foothills are dominated by the ESSF zone with the mountain tops consisting of BAFA tundra (DeMarchi 1995).

The wild and unsettled nature of this area provides for a wide range of fauna, and black and grizzly bear, moose, caribou, wolf, lynx, marten and muskrat all occur in abundance here. This area is also the north-westernmost reach of the bighorn sheep (Grey 1994, Helm 2008).

The Sub-Boreal Interior ecoprovince is represented by the Central Canadian Rocky Mountains Ecoregion within the study area.

Figure 2. Monkman Creek and the Hart Ranges.

Central Canadian Rocky Mountains Ecoregion

The Central Canadian Rocky Mountains are characterized by steep, rounded mountains which are lower than adjacent Rocky Mountain ranges to the south and north. This ecoregion has four ecosections within the Peace Forest District: the Hart Foothills, the Hart Ranges (Figure 2), the Misinchinka Ranges and the Peace Foothills ecosections.

Low, rounded mountains with wide valleys and dry, cold Arctic air are typical of the Hart Foothills ecosection. It is located on the eastern side of the Rocky Mountains.

The Hart Ranges ecosection is made up of relatively low mountains which increase in elevation from north to south. The peaks form a barrier to easterly flowing air from the Pacific and south-westerly air from the Arctic. Both the Hart Ranges and the Hart Foothills are located within the Pine River watershed.

The Misinchinka Ranges are high, steep mountains, with narrow deep valleys and plenty of precipitation from moist Pacific air that settles over the mountains. The Upper Peace-Halfway River watershed flows through this ecosection.

Blocky mountains and deep valleys are characteristic of the Peace Foothills ecosection, which falls within the Upper Peace–Halfway River watershed (DeMarchi 1995).

Boreal Plains Ecoprovince

The Boreal Plains ecoprovince lies east of the Hart and Muskwa ranges of the Rocky Mountains within their foothills and on the upland plateaus and lowlands to the east towards the B.C./Alberta border. This portion of the study area is generally rolling to flat, with limited terrain relief. The Upper Peace-Halfway, Beatton, Fontas, Pine and Upper Peace-Kiskatinaw watersheds all flow into this ecoprovince from the mountains to the west. There is little moisture remaining in the air flowing into this region after crossing successive mountain ranges from the Pacific, and Arctic air flows freely into the air.

On the Boreal Plains, winters are generally cold and summers relatively warm. The low elevation terrain is typically forested by BWBS forest and aspen parkland. There are large areas of muskeg found on the upland areas within the ecoprovince. Higher elevation areas to the north of the Halfway River fall within the SWB Zone, with areas to the south within the ESSF zone.

Large areas of muskeg with well forested parkland support many large ungulates such as moose, deer and elk. Carnivores in this ecoprovince include black bear and wolves, although grizzly can be found occasionally. The Arctic shrew is also found in the Boreal Plains (DeMarchi 1995).

The Boreal Plains ecoprovince is represented by the Central Alberta Uplands, the Peace River Basin and the Southern Alberta Upland ecoregions within the study area.

Central Alberta Uplands Ecoregion

The Central Alberta Uplands ecoregion rises slowly above the Peace River to the south in a rolling plateau. There are two ecosections within this region found in the study area: the Clear Hills and the Halfway Plateau.

The Clear Hills ecosection is located in the northeast portion of the study area. It is a rolling upland that gently gains elevation to the north and east (DeMarchi 1995). This ecosection displays typical muskeg terrain with tracts of wetlands interspersed with terrestrial islands. The Beatton and Fontas watersheds flow from the west and north into the Clear Hills.

Some higher ridges and wide valleys distinguish the Highway Plateau ecosection from the Clear Hills to the northeast. The upland has rolling terrain and numerous wetlands and streams flowing south. The watersheds found within the Halfway Plateau include the Upper Peace-Halfway in the south and west, and the Beatton in the north and east.

Peace River Basin Ecoregion

The Peace River Basin ecoregion consists of a wide plain located between rolling uplands to the north and south dissected by the Peace River (DeMarchi 1995). The ecogregion is represented by the Peace Lowland ecosection.

Figure 3. A bull moose grazing in the Peace Lowland.

The Peace Lowland (Figure 3) is a relatively warm, low area with a number of large rivers culminating at the Peace River running through the ecosection. The Pine, Upper Peace-Kiskatinaw, Upper Peace-Halway and Beatton watersheds all flow through this portion of the study area.

Southern Alberta Upland Ecoregion

The Southern Alberta Upland ecoregion rises above the Peace River Basin to the north, becoming more rolling and gaining elevation to its culmination in the Rocky Mountain Foothills to the south. It is represented by the Kiskatinaw Plateau ecosection in the study area.

The Kiskatinaw Plateau Ecosection is made up of a flat upland dissected by the Murray, Kiskatinaw and Wapiti river systems, as a part of the Pine, Upper-Peace Kiskatinaw and Upper Wapiti watersheds. Within the upland plateau are numerous wetlands. The river valleys are relatively steep, deeply incised drainages running between well defined features of the Rocky Mountain Foothills (DeMarchi 1995).

Southern Interior Mountains Ecoprovince

The Southern Interior Mountains ecoprovince includes the Columbia Mountains, Continental Mountains, the southern Rocky Mountain Trench and the eastern flank of the Rocky Mountains. Only one small portion of the study area is represented by the Southern Interior Mountains, a small pocket at the southern tip of the Peace Forest District known as the Front Ranges.

The climate in the Southern Interior Mountains is strongly influenced by air masses moving from the west. Cold winters and relatively warm summers are the norm, with higher elevations remaining cool year round. The middle slopes of the Southern Interior Mountains fall within the ESSF biogeoclimatic zone. The upper elevations are within the Alpine Tundra zone, which is represented by BAFA within the project area.

The rugged terrain in this ecoprovince provides for the access and shelter required for mountain goat populations, which is the most widely dispersed mammal in this ecoprovince. Deer, elk, caribou and bighorn sheep are also common. The highest carnivore populations are represented by grizzly and black bear. This ecoprovince is also rich with bird species, hosting 70% of the avifauna known to occur in BC ((DeMarchi 1995).

The Southern Interior Mountains are found within the Eastern Continental Ranges ecoregion within the study area.

Eastern Continental Ranges

Only one ecosection in BC represents the eastern slopes of the southern Canadian Rocky Mountains, the Front Ranges ecosection.

Parallel rows of ridges and valleys, with strong, consistent perpendicular wind are characteristic of the Front Ranges ecosection. The combination of strong, dry wind and cold Arctic air pockets create a lower elevation occurrence of the BAFA Alpine biogeoclimatic zone than elsewhere in the ecoprovince. Within the study area, the Upper Wapiti watershed encompasses the entire Front Ranges ecosection.

Taiga Plains Ecoprovince

The northernmost extent of the study area lies within the Taiga Plains ecoprovince. This relatively flat, expansive plain lies east of the Rocky Mountains at the border with BC, Alberta and the Northwest Territories.

Given this ecoprovince's distance from the mountains and other influencing climatic factors, it has a continental climate, with hot summers and cold winters. Long periods of cloudy and unstable weather result from its position between Arctic and Pacific air masses (DeMarchi 1995).

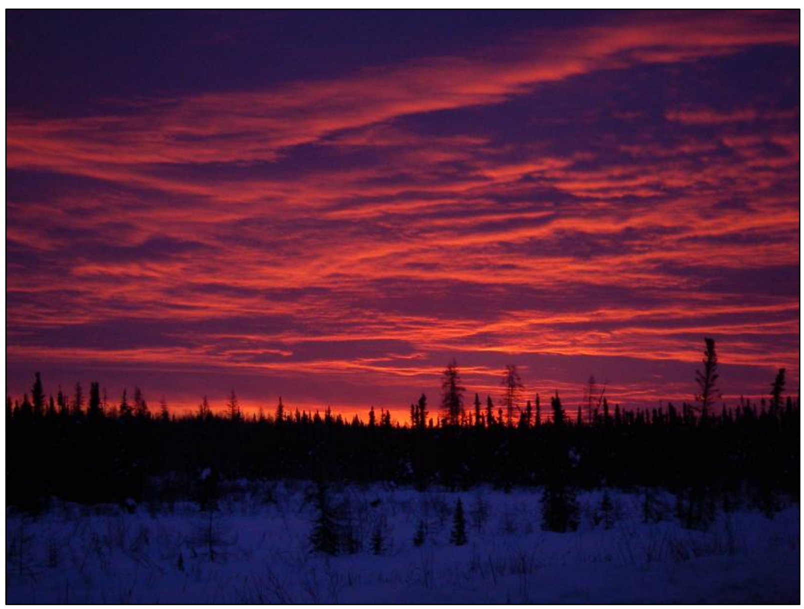


Figure 4. A winter sunrise in the Fort Nelson Lowlands.

Black spruce bogs are abundant in this low lying region, and BWBS forest occupy the entire area with patches of aspen parkland throughout. The wetlands supply excellent forage for moose, and scattered herds of caribou can also be found in the upland areas. Black bear, lynx and wolverine are common carnivores in the Taiga Plains.

The Taiga Plains are represented by the Hay River Lowland ecoregion within the study area.

Hay River Lowland Ecoregion

The Hay River Lowland lies to the south of the Alberta Plateau in the northern reach of the project area. It is a wide expansive lowland represented by the Fort Nelson Lowland ecosection.

The Fort Nelson Lowland (Figure 4) is a relatively flat, open expansive region with wide river valleys bisecting the muskeg and terrestrial island terrain. The Fontas and Sikanni Chief watersheds flow throw the ecosection.

Northern Boreal Mountains

Part of the Polar ecodomain, the Northern Boreal Mountains ecoprovince is rugged country with the eastern Muskwa mountains and foothills and intermontane lowlands in the north-western edge of the project area.

Figure 5. The Muskwa Kechika Management Area has wide valleys and high, rugged peaks.

The climate in the Northern Boreal Mountains is cold and severe. Air from the Pacific has lost its moisture by the time it crosses to the eastern slopes of the Muskwa range, and this area falls within a rainshadow. The valley bottoms fall within the BWBS biogeoclimatic zones, with higher valleys and middle slopes forested by SWB and BAFA on alpine peaks.

The wilderness of this area has been protected by the Muskwa Kechika Management Area (Figure 5), and healthy populations of caribou, moose, elk, thinhorn sheep and mountain goat can all be found in the ecoregion. Grizzly bear, black bear and wolves are abundant throughout the valleys, as are wolverine and lynx. Small mammals such as pika, Arctic ground squirrel, tundra vole and brown lemming are also found here (DeMarchi 1995).

The Northern Boreal Mountains are represented by the Northern Canadian Rocky Mountains ecoregion within the study area.

Northern Canadian Rocky Mountains

This ecoregion is typified by high, rugged mountains, rolling foothills and wide valleys. There are two ecosections of the Northern Canadian Rocky Mountains within the study area: the Eastern Muskwa Ranges and the Muskwa Foothills ecosection.

The Eastern Muskwa Ranges ecosection has jagged, formidable peaks with high levels of snowfall. The Muskwa, Sikanni Chief and Upper Peace-Halfway watersheds are all a part of this and the Muskwa Foothills ecoregions.

Lower, gentler mountains are found in the Muskwa Foothills ecosection, separated by wide valleys. It falls in the rainshadow from the Rocky Mountains to the west (DeMarchi 1995).

3.2 Ethnographic Background

3.2.1 Overview of Traditional Economy

Aboriginal groups in northern British Columbia are customarily distinguished by egalitarian societies. Traditionally, they depended on hunting and gathering for their sustenance, and the annual cycle of subsistence activities and settlement was dictated by the seasonal availability of food resources. These groups developed an intricate and intimate knowledge of the landscape and its available resources. The seasonal round was characterized by regulated mobility according to detailed knowledge of where, when, and how land and animal resources were most efficiently accessed. Material technologies were also highly efficient and easy to transport. The material culture for hunting, trapping, fishing, and building technologies were designed to be expedient for mobility and easy replacement; however, the knowledge employed in their construction and use was immense. The material culture was typified by tools of wood, bone, and antler, as well as chipped stone. Basketry, mats, and bark containers were abundant. Dugout canoes were the principal watercraft, and were locally made from cottonwood logs or spruce bark over a pole frame. Game was most often killed from ambush, though deadfalls were used for bears and brushwood enclosures or fences were built to corral deer.

Little is known of the specific seasonal movements of the aboriginal peoples of the Peace River region prior to the arrival of the fur trade which brought the Cree and Saulteaux to the region. The ethnographic descriptions provided by anthropologists are based on the modern and historic use of the landscape when traplines and trading posts were already long part of the First Nations economy.

Traditionally, several species of animals were hunted as part of the seasonal round. Large game predominantly included moose, elk, caribou, deer, and bison, but bears and mountain goats would have been hunted when and where available. Smaller mammals were more important as fur-bearers than supplementary food-sources. These animals continue to be a staple in the First Nations diet and economy. The historic abundance of large hunting game in the Peace River region was documented by Alexander Mackenzie in 1793 at a location thought to be Jim Rose Prairie or Bear Flats (north bank of the Peace River):

> *Mr Mackay, and one of the young men, killed two elks, and mortally wounded a buffalo, but we only took a part of the flesh of the former. The land above the spot where we encamped, spreads into an extensive plain and stretches on to a very high ridge, which, in some parts, presents a face of rock, but is principally covered with verdure, and varied with the poplar and white birch tree. The country is so crowded with animals as to have the appearance, in some places, of a stall-yard, from the state of the ground, and the quantity of dung which is scattered over it. The soil is black and light. We this day saw two grisly and hideous bears (Mackenzie 1971:164).*

A variety of food plant resources were available to northern communities which included highbush cranberry, Saskatoon berry, chokecherry, Indian-potato, and avalanche lily. Pine and spruce trees were used as sources of firewood and bark, while cottonwood trees were used for making dugout canoes. The cambium of lodgepole pine trees were also likely accessed as a food resource, although the use of cambium does not appear to be as widespread or intensive as in the central interior of B.C.

Other plants, such as rushes and riparian grasses, had technological uses as weaving materials, and a diverse assemblage of additional species were utilized for medicinal purposes.

The present-day inclusion of First Nations members or administrations within the general wage economy should not be considered at odds with traditional lifeways and activities. The development of a mixed hunting / trapping / gathering / wage labour began with the arrival of the fur trade in A.D. 1793, and has continued to develop to the present.

3.2.2 Ethno-Linguistic Affiliation

Beaver (Dunne-za)

The hunting economy of the *Dunne-za* focused on moose. Due to the size of the animal, and its relative abundance, moose provides a very efficient return of effort. Also important to the hunting economy are deer, mountain goat and caribou. Due to declines in populations, mountain goat and caribou likely have a diminished role in the current hunting economy compared to the historic period.

The year was comprised of five seasons corresponding to harvesting activities. These included: the dry meat hunt, early winter hunting and trapping, late winter hunting and trapping, the spring beaver hunt, and the summer slack (with plant gathering). An extensive knowledge of the land, resources and of the ecosystems upon which they depended made for a rich variety of traditional foods and activities. Berries were gathered and dried during the summer months, gardens were planted in the spring and people left for their winter camps during the fall. Smaller hunting groups would usually come together during the summer at the appointed reserves (Saulteau First Nations et al. 2006).

Culturally, the Blueberry River First Nation, Doig River First Nation, Halfway River First Nation, Prophet River First Nation and West Moberly First Nations are Beaver people, or *Dunne-za* ('real people'). Their language, Beaver, is part of the Athapaskan language group (Ridington 1981). Descriptions of traditional Athapaskan culture and language can be found in the writings of anthropologists Goddard (1916), Jenness (1937), Honigmann (1946), Asch (1981), Denniston (1981), Krauss and Golla (1981), and Ridington (1981, 1988, 1990).

The most recent summary of traditional Beaver culture is by Ridington (1981). Today, these communities also include significant populations of, or descendents of, Cree or Saulteaux speakers. Both Cree and Saulteaux are Algonquian languages (see below).

Until 1977, the Blueberry River and Doig River First Nations together formed the Fort St. John Band. The signing of Treaty 8 in 1899 resulted in the allotment of a reserve to the Fort St. John Band immediately north of present-day Fort St. John. These same lands were then sold to the Veterans Association following World War II, and were awarded to returning veterans. In 1959, three new reserves were established, two of which are the current locations of the Blueberry River and Doig River First Nation reserves.

A number of traplines are registered to Blueberry River First Nation band members. The traplines cover an area extending from the area around the Blueberry River reserve northward to the Sikanni Chief River, east to the Milligan Hills, and west to the Blueberry River. This same area is also considered to be the core hunting area of the Blueberry River First Nation people. Lands south of the present day reserve are no longer productive hunting or trapping areas, due to the expansion of agriculture and ranching, as well as industry expansion in forestry and oil and gas. Off reserve hunting camps are set up along the valleys of Blueberry Creek, Aitken Creek and Nig Creek (Brody 1981).

Historically, and to the present, the Doig River First Nation members have hunted and trapped within the Beatton River watershed east of the river, north to the Milligan Hills, and east almost to the Clear Hills in northern Alberta (Brody 1981). The southern limit of the hunting and trapping range has been affected by continuing agricultural expansion northward from Fort St. John as well as industry expansion in oil and gas.

Prior to 1975, the Halfway River and West Moberly First Nations together formed the Hudson's Hope Band. The Halfway River reserve was allotted as early as 1925, but did not become the permanent settlement of the Band until 1961. Similarly, the West Moberly First Nations reserve was allotted in 1916, but was not permanently occupied until a later date. Prior to 1961, the principal residences of the Halfway River people were at Stoney, along the Chowade River, located north of the present-day community (Weinstein 1979).

The traditional hunting and trapping territories of the Halfway River and West Moberly First Nations are the foothills and mountains of the Rockies. Hunting and trapping occurred as far westward as the Ospika River, located on the western slope of the Rockies in the Rocky Mountain Trench. Prior to 1975, the Halfway River and West Moberly First Nations were administratively part of the Hudson's Hope Band. The Halfway River reserve was allotted as early as 1925, but did not become the permanent settlement of the Band until 1961. Prior to 1961, the principal residences of the Halfway River people were at Stoney, along the Chowade River (located north of the present-day community). The typical historical seasonal round would have included occupation along the Chowade River during the snow-free seasons, and dispersal to family trap-lines during the winter, with use of areas for hunting as far north as the Sikanni Chief River and to the south side of the Graham River in the south (Brody 1981). With the arrival of the fur trade, core resource use for families now a part of West Moberly First Nations was focused around Moberly Lake and surrounding lands. Boucher Lake, Cameron Lakes, Moberly River and the Pine River remain important areas for hunting and gathering for the Saulteau and West Moberly First Nations (Saulteau First Nations et al. 2006).

Saulteaux

The Saulteau First Nations was originally comprised of Saulteaux and Cree speakers. The Saulteaux name is from the French "saulteurs", referring to "the people of the rapids" (Asikinack 2006). It originally applied to the Ojibwa people found at Sault Ste Marie, but later came to refer to all speakers of the western most dialect of the Ojibwa people (Yinka Dene Language Institute 2006). In their language their name is *Nahkawininiwak* (Asikinack 2006). The history of the Saulteau First Nations members relates that the ancestors of the present day Saulteau First Nations people from southern Manitoba (Steinberg 1981) were starving on their reserve from a lack of wild game and the law against butchering their own cattle which had been allotted to them by the Canadian government to be kept as a source of income. In desperation some cows were butchered for meat resulting in the detainment of several community members by the Royal Canadian Mounted Police. During this time the Saulteau leader, *Napaneegwan* ("One Wing" in Saulteaux), had a vision and told his people they needed to flee and make a trip to twin peak mountains with a lake below it (Neeso Watchie et al. 2006). The ancestors of the Saulteau First Nations membership felt that Moberly Lake, backed by the Beattie Peaks to the west, fit with the vision and settled at the lake, On their long journey west from southern Manitoba, the Saulteau First Nations people intermixed with Cree people of the plains and woodlands resulting in the adoption of the Cree language among other cultural aspects. While the people of Saulteau First Nation retain affiliation with Saulteaux culture, the Cree and Beaver languages have become the main First Nations languages of the community, with only a few elders remaining that speak Saulteaux (Yinka Dene Language Institute 2006).

Saulteau First Nations people have historically hunted and trapped the lands south of the Peace River, and east of the Rocky Mountains since their arrival in the region in the late 19th century (Leonard 1995). This area includes lands within the Murray and Sukunka River watersheds, as well as northward within the Kiskatinaw River watershed to the Peace River. With their eastern woodland and plains background, the Saulteau of northeastern BC had an economy based on a mix of woodland trapping, fishing, and plains bison hunting culture (Heritage Community Foundation 2002b). As with the *Dunne-za* described above, moose was/is the mainstay of the hunting economy. The Saulteau First Nations hunting economy also includes deer, mountain goat and caribou, but as with the *Dunne-za*, declines in animal populations, have likely let to a diminished role for mountain goat and caribou in the current hunting economy compared to the historic period. Differing from *Dunne-za* groups, Saulteaux peoples are more engaged in fishing. Moberly Lake has populations of whitefish, pike, lake trout, greyling, ling cod, and suckers that were caught in a net fishery, although, this technology has declined in recent times due to pressures from the Fish and Wildlife Branch of the provincial government and the increase of motor boats on the lake (Weinstein 1979).

Traditionally, the seasonal round of the Saulteaux included winter hunting (moose, caribou, deer), fishing, and trapping in the Rocky Mountain foothills. Spring included trading furs at Chetwynd or Hudson’s Hope, followed by the spring beaver and muskrat hunt. Summer was typically spent around Moberly Lake. The fall included a fairly intensive moose hunt to provision dry meat for the winter. Saulteau elders recall people packing horses and making dry meat, pounded meat and pemmican. Hunting parties would go out around Big Lake or Swan Lake about 20 km south of Pouce Coupe, and people would spend days at the numerous berry picking areas around the Moberly River (Saulteau First Nations et al. 2006). Following the fall moose hunt, families would again disperse to family held traplines.

A number of traplines are registered to Saulteau First Nation families. Trapping played a very significant role in the Saulteaux economy, but due to declines in fur bearing animals in recent years, as well as a general decline in the prices for furs, the importance of trapping has significantly declined.

Similarly, hunting has also seen a decline in the availability of animal resources and undisturbed animal habitat. Historically, the Saulteaux hunted a very large area (as described above), but presently, the core of Saulteau First Nations hunting territory is located north of the present-day reserve, centred around the Moberly and Pine River, as well as Boucher Lakes. There is still a vigorous hunting economy within the Saulteau community.

Sekani

The McLeod Lake Indian Band members are Sekani people. Their language is *tsek’ehne*, a Carrier word meaning “people of the rock” (Verne Solonas, personal communication 2008). *Tsek’ehne* is also an Athapaskan language. Sekani and Beaver peoples have a similar language and culture, suggesting a common past. Sekani people historically were a nomadic hunting and gathering people. Their lifestyle and preference for big game required a large hunting area. Sekani peoples traditionally occupied both the eastern and western slopes of the Rocky Mountains in a seasonal round (Harmon 2006; Innis 1970; Denniston 1981; Burley, Hamilton, and Fladmark 1996). Harmon, a fur-trader, encountered Sekanis in 1810 at Rocky Mountain Portage on the Peace River system and described the Sekani as a people who lived on both the east and west side of the Rocky Mountains in northern British Columbia. Late fall to early spring was spent on the eastern side of the mountains where large game was plentiful, whereas winters were spent on the western side of the mountains where fishing figured largely in the traditional economy (Harmon 2006).

Westward pressure exerted on the Beaver by the Cree in the 1800's in turn forced the Sekani to recede to the Rocky Mountain Trench and the western slope of the mountains. Alexander Mackenzie was the first European to enter the traditional territory of the Sekani. Contact between Europeans and the Sekani reportedly occurred on June 9, 1793, on the Parsnip River in the Nation River area. The Sekani contributed heavily to the fur trade economy at the Rocky Mountain Portage House, Fort Grahame, and Fort McLeod posts. There are a number of traplines that continue to be held by members of the McLeod Lake Indian Band. Hunting, fishing and berry picking remain important activities for food procurement and all three activities are undertaken by community members of all ages (Verne Solonas, personal communication 2008). The McLeod Lake Indian Band continues to occupy the land adjacent to the Fort McLeod trading post.

Slavey (Dene)

The Slavey (or Dene) people are Athapaskan speakers from the sub-Arctic who have traditionally occupied the lands along the Slave and Mackenize Rivers in small, semi-nomadic groups, and include the Fort Nelson First Nation who have traditionally occupied lands to the south and west of these rivers in northern BC (Asch 1981). While their seasonal round focused on large ungulates such as caribou and moose, their subsistence base was fish, given the abundance of large waterways within their territory. People would gather in camps along the rivers in the summer to catch large quantities of fish which would be cleaned and then smoked to preserve the harvest for winter (Allen 2009). Fresh fish and game were also taken in the winter. The people of Fort Nelson First Nation continue to depend on the waterways as a means of transportation year round to access the abundant fish and game that occupy the valleys (James Needlay, personal communication 2009).

The Dene people's land is characterized by large tracts of muskeg swamp interspersed with small terrestrial islands and upland plateaus which served as travel corridors. Summer travel took advantage of the river systems and spruce or birch bark canoes were used to maneuver the waterways. Winter travel was entirely on foot, and accomplished via snowshoe, with narrow, long snowshoes used for breaking and following trails, and wider, short snowshoes used for tracking animals (Asch 1981, Honigmann 1946). A hunter would run the large game through deep snow in the winter, where the animal would tire easily in the deep snow, and the hunter would remain on top of the crusty snow with snowshoes. Snares were also used to catch both large and small game. The people of Fort Nelson First Nation have traditionally hunted and continue to hunt along the Muskwa, Fort Nelson, Kahntah and Fontas Rivers and their tributaries, Maxhamish Lake and other smaller lakes (Brody 1981).

Cree

Throughout the 17th and 18th centuries, Cree peoples had established themselves as middlemen in the fur trade industry (Smith 1981). Many Cree groups followed the fur trade west, and settled in western Canada throughout the 18th and 19th centuries. The possession of European firearms allowed the Cree to displace other aboriginal groups during the westward expansion. A truce was formed between the Beaver and Cree in the late 1700's at Peace Point, located along the lower Peace River upstream from Lake Athabasca, resulting in the abandonment of the Lake Athabasca region by the Beaver (Calverley 1980). The agreement was that the Beaver would remove to north of the Peace River, while the Cree would remain south of the river (Burley, Hamilton, and Fladmark 1996).

The Cree people of northeastern British Columbia began arriving in the region in the late 1700's (Burley, Hamilton and Fladmark 1996). Prior to the arrival of Europeans, both Woodland and Plains Cree were a mobile people. Plains Cree are known for their large teepee settlements and their skill at hunting the bison and the wapiti. Woodland Cree also traditionally hunted the bison in addition to other large ungulates found in the boreal forest. They lived in birch bark or hide covered conical lodges, dependant on the time of year and available resources (Heritage Community Foundation 2002). With the introduction of the fur trade, the Cree continued to move, following the fur trade posts and economy. Many Cree who have settled in the Peace area first came to the region as guides for fur traders (Kelly Lake Cree Nation 2008). Many Cree people remain in the Peace River region and have intermarried with the Beaver and Saulteaux. The Cree language remains strong in many of the Treaty 8 and Kelly Lake communities.

Métis

The Kelly Lake Métis Settlement Society (KLMSS) is comprised of aboriginal people from intermixed cultural heritage. The first families to settle at Kelly Lake had followed the fur trade economy north and west in the 18th century from as far away as Quebec and Manitoba, and included Cree, Iroquois and Beaver people (Calverley 1980; Slobodin 1981). A number of Cree and Iroquois families who make up the Kelly Lake community today were inhabitants of the Jasper area prior to its status as a National Park and were displaced when the park was created. Métis and Cree trappers moved west from Lac St Anne, northwest of Edmonton, Alberta, to Grande Prairie, Alberta, approximately 400 km further northwest, in search of abundant game and new opportunities. Some of these families continued southwest to settle at Kelly Lake. An annual pilgrimage to Lac St Anne is still undertaken by many of the KLMSS elders. While the people of Kelly Lake come from a varied cultural landscape, Cree is the primary traditional language spoken in the community. When the first school teacher, Gerry Andrews, arrived in Kelly Lake in 1923, his students were fluent in Cree and could not speak English (Andrews 1985). Today English is spoken fluently throughout the community.

The governance of the Kelly Lake Métis community is managed by the Kelly Lake Métis Settlement Society (KLMSS). The Society, located in Grand Prairie, Alberta, is responsible for overall community leadership, economic development, social services, education, health, and resource management. The KLMSS board consists of five board members, including an elder or director. The KLMSS is in the process of claiming aboriginal rights to traditional lands via litigation against the Province of BC that was registered on June 12, 2006.

The Métis people at Kelly Lake have always been hunters and trappers, and continue to subsist on a traditional economy. The Kelly Lake Métis Settlement Society members hunt and tap throughout the Wapiti and Redwillow River drainages, and through the foothills of the Rockies near the BC/Alberta border. Hunting and trapping are important food and income sources to community members.

3.3 Archaeological Background

3.3.1 Pre-Contact History (History prior to first contact with Europeans)

The western subarctic, including northeastern British Columbia, has been occupied by people for a very long time. A generalized summary of pre-contact archaeology in British Columbia has been prepared by Knut Fladmark (1982, 1986, 1996) with generalized summaries of the subarctic and western subarctic available in Donald Clark (1981, 1991). In addition, Helmer (1977) focuses on the Central Interior of BC, Vickers (1986) summarizes the pre-contact history of Alberta, and Clark (1981) describes western subarctic prehistory. West (1996) compiles several papers by authorities working in central and northern Alaska.

Archaeological research conducted within the study area has primarily involved non-systematic site surveys and oil and gas industry-related AIAs. Although a large volume of archaeological impact assessments have been conducted by several cultural heritage resource management firms for petroleum and forestry developments in the last decade, very few research-based projects have been conducted in the study area. As a result, there are only a few archaeological sites that have been scientifically excavated and subjected to accurate dating methods. This lack of local information has forced researchers to compare ancient tools recovered in northeastern B.C. to adjacent geographic areas. As such, the almost 11,000 years of pre-contact human history has been divided into three broad time periods: Early Prehistoric period (10,500-7500 Before Present [BP]), Middle Prehistoric period (7500/7000-3500/2500 BP), and Late Prehistoric period (3500/2500 BP – Contact with Europeans). Research to date indicates that an environment habitable by people had developed in this region by at least 11,600 years before present (Churcher and Wilson 1979; White 1983). Artifacts associated with the Early Prehistoric period have been identified at numerous archaeological sites throughout northeast B.C. Evidence from the Charlie Lake Cave Site (HbRf-39) suggests the Early Prehistoric period in the region began around 10,500 years BP (Fladmark et al. 1984; Fladmark et al. 1988; Fladmark 1996; Handly 1993; Driver et al. 1996). Early Prehistoric material culture appears to be broadly comparable to the northern plains of Alberta (Howe and Brolly 2008). Similarly, later material cultural in the Middle Prehistoric developed along lines akin to those defined for the Plains. Late Prehistoric styles also mirror the Plains sequence, although a north-south split may be present with Plains styles appearing in the south Peace River Regional District, and Yukon styles appearing in the northern portion of the Peace River Regional District (Howe and Brolly 2008). In general, archaeological evidence in the broader region surrounding Fort St. John indicates that the area has been continuously occupied for at least 10,500 years.

Some general comments can be made regarding the nature of the sites which have been recorded in the region. Most of the recorded archaeological sites are stone artifact scatters and are located adjacent to major water features, such as rivers or large lakes. The recorded site density is generally higher in the south portion of the study area than in the north. At the same time, more archaeological investigations have taken place in the Peace River area than elsewhere in the study area. The archaeological sites in this area date to between 10,500 years BP to 200 years BP, and include scientifically significant sites such as Charlie Lake Cave (HbRf-39; see Fladmark 1996, Fladmark et al. 1984; Fladmark et al. 1988), Farrell Creek (HaRk-1; see Spurling 1978, 1980; Howe and Brolly 2008), Gutah Creek (HkRe-1; see Heritage North Consulting Limited 2010; Howe and Brolly 2008) and Pink Mountain (HhRr-1; see Wilson 1989, 1996).

3.3.2 Post-Contact History

The earliest contact between aboriginal and non-aboriginal people in the Peace River region took place in 1793 when Alexander Mackenzie journeyed through the area while seeking a trade route between eastern Canada and the Pacific Coast (Mackenzie 1971). He traveled up the Peace River to Finlay Forks and then south up the Parsnip River, to the McGregor River and then to Fraser River before proceeding south and west to the Pacific Ocean following well-established aboriginal trail systems (Burley, Hamilton, and Fladmark 1996; Fladmark 1985; Mackie 1997). A North West Company fort, Rocky Mountain House, was established near the confluence of the Moberly and Peace Rivers in 1794 (Burley, Hamilton, and Fladmark 1996). Aboriginal trappers became the primary suppliers of furs to the North West Company in the Peace River region.

Continued exploration of the region by John Finlay, James McDougall and Simon Fraser led to the establishment of two additional trading posts for the North West Company. The first was Rocky Mountain Portage near present day Hudson Hope and the other was Fort McLeod at Trout Lake (now McLeod Lake) in 1805. These events marked the beginning of continuous contact between First Nations and those of European descent. Aside from fur-trapping, First Nations' people were also employed in supplying the traders with game. Both local native trappers and the fur traders initially viewed the exchange of furs and trade goods at trading posts as economically beneficial (Burley, Hamilton, and Fladmark 1996).

Additional North West Company, and in 1819 Hudson's Bay Company, forts were established in the region including: Fort McLeod, established in 1805 at McLeod Lake; Fort d'Epinnette (renamed Fort St. Johns in 1821), built in 1806 near the mouth of the Beatton River; Fort St. John on the south bank of the Peace River, directly south from the present-day community, in the 1860's; Fort St. John, built in 1872, on the north bank of the river across from it's previous location; and Fort St. John, built in 1925 along Fish Creek, northwest of the present day community. The expansion of the fur trade in the Peace River region took place over more than a century. In contrast to other parts of the country, conflicts between aboriginal and non-aboriginal inhabitants were few. Aside from minor incidents, the only major conflict occurred in 1823 with the "Massacre of St. Johns." The conflict arose over the closing of Fort St. Johns and resulted in the deaths of five Hudson's Bay Company employees (Burley, Hamilton, and Fladmark 1996).

In 1913, the first permanent non-aboriginal settlers arrived in the Peace Region. The settlers occupied portions of a 3.5 million acre parcel of land awarded by British Columbia to the federal government in payment of the BC portion of the national railway. In the 1920's, additional farmers arrived from the prairies after drought had devastated parts of central Canada.

It was only with the arrival of construction parties of the Pacific Great Eastern Railroad (now BC Rail) railway after World War II, that more intensive land use took place. The region saw further economic expansion with the completion of the Alaska Highway, and later Highway 97, and the construction of the W.A.C. Bennett dam. In 1951, the first gas well at Fort St. John went into production, marking the beginning of major industry in the region.

The arrival of settlers and later industry had varying effects on First Nations. Lands that had previously been accessible only by trail were now open to aboriginal and non-aboriginal peoples by road and agricultural and industry expansion put increasing pressures on wildlife populations. Profitable hunting areas moved increasingly further away from the growing urban centres, and traplines were negatively affected by a loss of habitat.

4.0 POTENTIAL DEVELOPMENT ACTIVITIES WITHIN THE STUDY AREA

British Columbia's northeast region is rich with minerals, gas, healthy forests and large rivers. While the Peace AOA Model has been developed primarily for use in the forestry sector, a number of other activities occur within the study area, and it is anticipated that these other industries will benefit from use of the new model.

The oil and gas industry within the project study area has been active since the 1950's when the first gas well was drilled by Fort St. John. This industry continues to thrive in the study area, building on technological advances in shale gas extraction. Roads, wellsites, pipelines and other associated gas industry developments are expected to continue throughout the Peace Forest District.

The south eastern portion of the study area has large coal reserves, and indications are that coal mining will continue to develop in the hills and mountains south of the towns of Tumbler Ridge and Chetwynd. These foothills to the Rockies, as well as those to the north, have a new industry developing: wind energy. The first operation wind turbines in BC are found at Bear Mountain, just south of the city of Dawson Creek, in the study area. The strong, consistent winds of the Rocky Mountains of north-central BC have elicited interest from wind energy companies country wide, and the recent Call for Green Power from BC Hydro indicates a number of new wind energy projects will be constructed in the south Peace region, near Tumbler Ridge and Chetwynd. Turbine pads, transmission lines and access roads are all associated with the new developments.

BC Hydro's dam system along the Peace River may also benefit from use of the new model, as the proposed Site C dam is located along the Peace River, just south of the city of Fort St. John, within the study area.

5.0 METHODOLOGY

5.1 Data Sources

Modelling was based on British Columbia TRIM (Terrain Resources Information Management) mapping, including a Digital Elevation Model (DEM) and line and polygon features such as rivers and lakes. The DEM, in its raw data state, consists of mass elevation points covering the landscape at a spacing of 50 to 100 m apart, as well as breaklines which are intended to define major features such as sharp and rounded breaks in slope (for example, cliffs and ridge-tops), streams, roads, and other water features. DEM processing consists of interpolating these point and line features to create a continuous raster grid, with cells containing elevation values. For this project, the DEM was processed as a series of 1:250,000 mapsheet letter-blocks based on the NTS grid, with a 25 m cell size (see Figure 1). Several variables were generated from this DEM, as listed in Table 1. Other variables used in modelling include water features from TRIM mapping, also listed in Table 1.

Custom AML (Arc Macro Language) scripts were developed by Millennia Research Limited and Timberline Natural Resource Group during previous modelling projects. These consist of a series of moving windows which analyze the input DEM and output several different variables. The moving windows include a 25 by 1 cell horizontal window, a 1 by 25 cell vertical window, and a 9 by 9 cell square moving window. The results produced from the analysis include:

- "Positive" – this refers to the sum of the differences (in meters elevation) between the central cell in the window and all cells with lower elevations than the central cell. This is run using both 25 by1 moving windows and the 9 by 9 window.
- "Negative" – this is similar to the "Positive", except that it calculates the sum of the negative differences (i.e. between the central cell and all cells with higher elevations than the central cell). This is run with both 25 by 1 moving windows.
- "Positive count" or "Count" – this is the count of all cells with elevation values lower than the central cell. This is run using the 9 by 9 moving window.

These variables can be combined to identify locations that are the tops of hills, knolls, ridges, terraces, etc. The count variable can identify hilltops and ridges, but does not discriminate between large and small, or even barely discernable features, while the positive value identifies the magnitude of the landform.

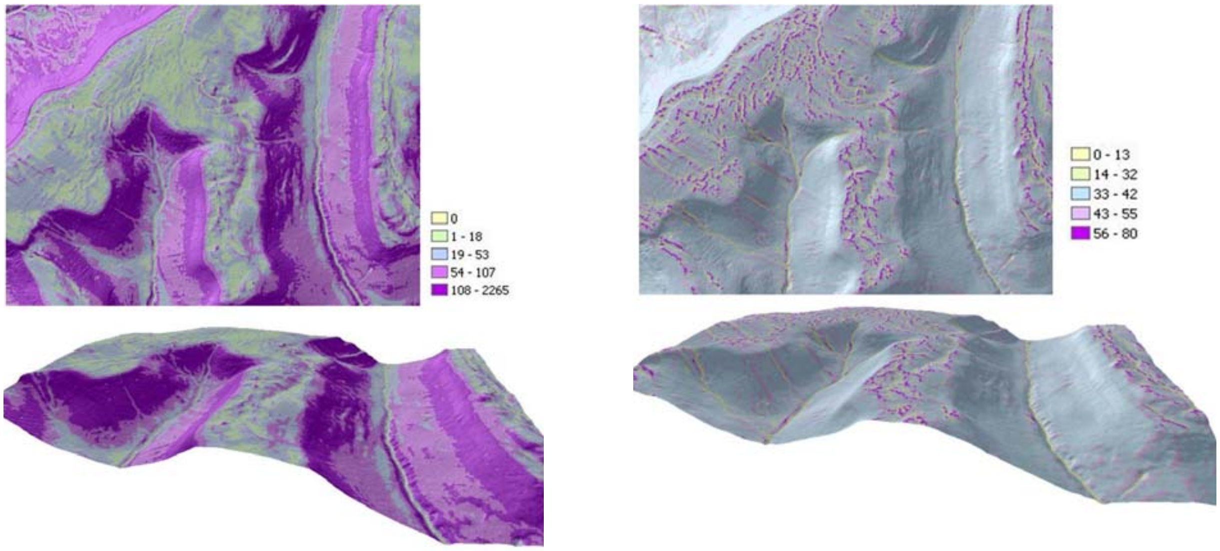


Figure 6. Left - example of "positive" variable - higher values (darker purple) are assigned to larger terrain features; right - example of "count" variable - higher values (purple) identify tops of landforms, lower values (yellow) identify swales and creek courses

Other derivatives of the elevation data used for modelling include slope and the range of slope over a 9 by 9 cell window. This range was used in combination with other variables to identify relatively flat areas in close proximity to steep slopes.

Table 1. Data used in modelling.

TRIM water feature variables	DEM variables
Large lakes (> 1000 ha)	Slope
Medium lakes (>100 ha & ≤ 1000 ha)	Range of slope 9×9
Small lakes (>5 ha & ≤ 100 ha)	Positive 25×1 (maximum of horizontal and vertical)
Very small lakes (>0.5 ha & ≤ 5 ha)	Negative 25×1 (minimum of horizontal and vertical)
Double-line rivers	Positive 9×9
Single-line definite rivers	Positive count 9×9
Marsh or swamp (wetlands)	

5.2 Modelling

Modelling was initially based on the Northeast BC AOA Model (Benson, et al. 2003). Statistical analysis was undertaken during that AOA to determine significant variables for the prediction of archaeological sites. In the case of water features, these analyses determined it there was a relationship between archaeological sites and water features; if a relationship existed, the analyses determined at what distance the density of archaeological sites decreased below 'random' from the water features. For the current project, modelling started with creating a water feature based model using the buffer distance values for each water feature type based on those used for the Northeast AOA to buffer water features such as rivers, lakes and wetlands. Where two or more buffers overlapped, the area was included as part of the model (please see Appendix B for details of this model).

A DEM-based model was also created. The values for this could not be carried over from the Northeast AOA model, due to differences in cell size and DEM source between the previous and the current projects. Instead, for the Peace FD AOA model, the critical values or ranges of values for each DEM variable, and combinations of the variables, were determined through experimentation on a single letter-block; these values were then applied to the remaining letter-blocks. The validity of these values for identifying landforms with high potential in other letter-blocks was tested through a visual on-screen assessment of the preliminary model. This consisted of viewing the TRIM hillshaded DEM and manually identifying high potential landforms, then checking that they were captured by the model. The DEM-related values were determined so as to target certain landforms or parts of a landform with higher archaeological potential such as the edges of terraces, and tops of hills and ridges. Appendix A contains the details of this model, which is referred to below as the "terrain" or the "TRIM" model. The water and terrain models were initially combined, and a first round of ground-truthing completed. The results of the ground-truthing suggested that the water portion of the model was performing poorly, and, though capturing many areas of high potential, was also indiscriminately capturing very large areas of low potential as well. This model was therefore abandoned, as discussed in the Results section of this report and in Appendix C.

The model was then revised by removing the water feature based portion of the model entirely and using only the terrain model; further ground-truthing was performed to test this revised model. Based on the results of the ground-truthing, a variety of further revisions and refinements to the model were proposed and tested. These are discussed in detail in Appendix D. Several were tested, but not used, such as the buffering of river confluences and lakes, but the primary revisions, which were incorporated into the final model, involved the creation of revised terrain model layers, which expanded the potential to include smaller landforms.

5.2.1 Field Assessment and Heritage Inspection Permit #2008-0333

In April 2008, Ewan Anderson (Arcas) applied for a *Section 14* Archaeological Inspection Permit to conduct fieldwork in the Peace Forest District for the purposes of testing the preliminary Peace AOA model. This permit was required to conduct significant testing within the boundaries of known or un-documented archaeological sites, as a possible consequence of ground-truthing the preliminary model. Permit 2008-0333 was issued by the Archaeology Branch, Ministry of Tourism, Culture and the Arts on August 14th, 2008.

Although the primary goal of the ground-truthing was to assess the ability of the preliminary model to predict observed archaeological potential, all locations, regardless of potential assessment, received survey coverage including thorough inspection of the ground surface. Also, subsurface testing (e.g., shovel tests and trowel tests) at intervals ranging from 2 m to 15 m – depending on the size and configuration of the landform, surface exposure, vegetation (limiting factors would include standing trees and fallen trees), soil drainage quality, and other considerations – occurred in only two localities. In all surveyed lands, the surface was examined for archaeological features (food storage pits, hearths, etc.), artifacts, and other evidence of past settlement and land use, such as trails and culturally modified trees (CMTs).

Subsurface testing using shovels or trowels were used to locate buried archaeological remains. Subject to subsurface constraints, subsurface tests were excavated through all sediments likely to contain cultural materials to definitive non-archaeological sediments (e.g., glacial till). Subsurface tests minimally measured approximately 40 cm × 40 cm. Backdirt from the tests was examined manually or screened through 6 mm (or finer) mesh and all tests were backfilled upon completion.

As noted above only two localities were subsurface tested. During the first phase of the ground-truthing it soon became apparent that subsurface testing was not required to confirm the assessment of the model and was abandoned for the duration of the subsequent field assessments. No archaeological sites were identified during the subsurface testing. The two localities were:

Flatbed Creek Locality

A total of 14 subsurface tests were excavated with negative results.

Quintette Lake Locality

Two non-matching locations (HiLo-023 and -024) were tested (24 and 13 subsurface tests, respectively) with negative results.

The complete results of the first phase of ground-truthing the preliminary model are presented in Appendix G which is provided per the conditions of Heritage Inspection Permit #2008-0333.

5.2.2 TUS Data Incorporation

Traditional Use Study (TUS) data was provided by the Kelly Lake Metis Settlement Society as digitized polygons and lines, as well as by the McLeod Lake Indian Band as interviews, from which a digital data set was created by Arcas Consulting Archeologists Ltd. All traditional use types were treated the same. Arcas Consulting Archeologists Ltd. had already filtered the data to emphasise activities that might leave archaeological evidence (or those likely to be associated in some way with such evidence). Cabin sites tend to directly co-occur with lithic scatters (they are targeting the same landforms), and furthermore, they indicate a concentration of activity in the general area. Trails too are known to be strongly correlated with higher site density; in the Millennia NE five-year study, trails had the strongest predictive power for archaeological sites of any single variable (Eldridge and Anaya 2005). These data sets were incorporated into the modelling in order to reflect the high value placed on these areas by the local First Nations, as well as to reflect the higher use of these areas, and therefore, the likely higher archaeological potential, as areas used in the past tend to be the same areas used in traditional ways today. As the model is formatted so as to be a single-value model (i.e. modelling high potential, with no “moderate” class), additional terrain identification layers were developed specifically to be applied to the TUS area; these layers capture smaller, more marginal features that might otherwise be considered “moderate” potential, but which will be added to the model as high potential in the TUS areas. The actual values used to derive these layers are presented in Appendix A.

The TUS model layers were combined with the overall model; this results in the TUS areas being represented in the model, without being identifiable from the model. This is important in order to safeguard some highly sensitive and confidential data.

5.2.3 Final Model Creation

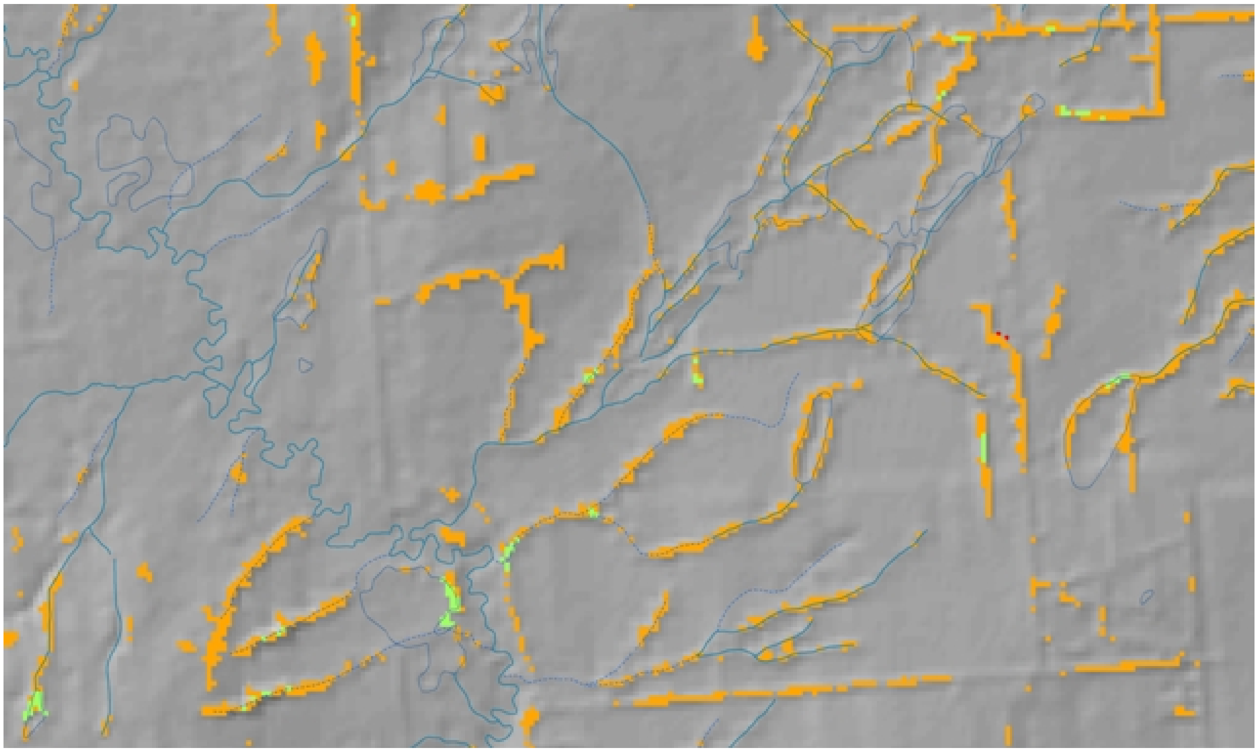
The final model was composed of the original terrain model, the revised terrain model, and the TUS layers (Appendix A). Recorded archaeological sites were first converted from polygon format to a 25 m cell raster grid, then added into the final model so as to be indistinguishable from the rest of the model while ensuring that they are represented by the model.

During modelling, there were a couple of types of "false" landforms that were being systematically captured by the model (Figure 7). One of these types of landforms consists of "raised streams", where the elevations assigned to the stream breakline in the TRIM are higher than those of the surrounding terrain. This type of error (which is usually within acceptable limits according to TRIM data specifications) occurs several places throughout the DEM. In the DEM and the model, it appears that the streams are running along the crests of ridges. It was relatively simple to remove these false captures from the model. Anywhere that a mapped stream coincides with a relatively high count value it is a false landform. High count values are associated with the tops of landforms – a stream should always have a fairly low count value as they are located in a gully or depression (even if not well-defined). Streams were therefore converted to a raster and intersected with the count layer (where count > 50); the resulting layer was then buffered by 1cell (25 m), and the final result was used to remove this false potential from the model (Figure 6).

The other type of "false" landform is not so easy to resolve. This is the case of roads being captured. Unfortunately, roads may well be built on ridge tops or other raised landforms, therefore the same methods used to clip out the raised streams does not apply for the roads. Simply clipping out all roads removes too much critical potential because, in order to effectively remove all of the false captures due to roads, they would need to be buffered before being used as a clip layer. This would result in a 75 m or larger swath being taken out of the model everywhere there was a mapped road, which would remove far too much valid potential. Therefore, roads were left in the model, and recommendations for use of the model will include this information.

Other TRIM DEM 'errors' (they are within TRIM tolerance) result in false 'terrace edges' where side-by-side lines of elevation digitizing have different calibration (Figure 7, Figure). TRIM allows for ± 7 m elevation variance from an accurate elevation for the DEM elevation points. This means that calibration for adjacent data entry regions could be as much 14 m different, and to the modeling formula, this appears to be a terrace edge. This not only occurs along map sheet joins (which might be relatively easy to select for and delete) but also occurs at essentially random locations within single mapsheets.

Single cells (modelled cells not surrounded by any other modelled cells) were not filtered out of the final model. At a 25 m cell size, a single cell may well represent a valid high potential location, and indeed, it was noted that some of the archaeological sites in the region are captured by a single cell of modelled potential.



7a)

7b)

Figure 7. TRIM errors captured by model. Note that many of the modelled "ridges" (a) are in fact mapped as TRIM streams, while others can be seen in the orthophoto to be roads (b).

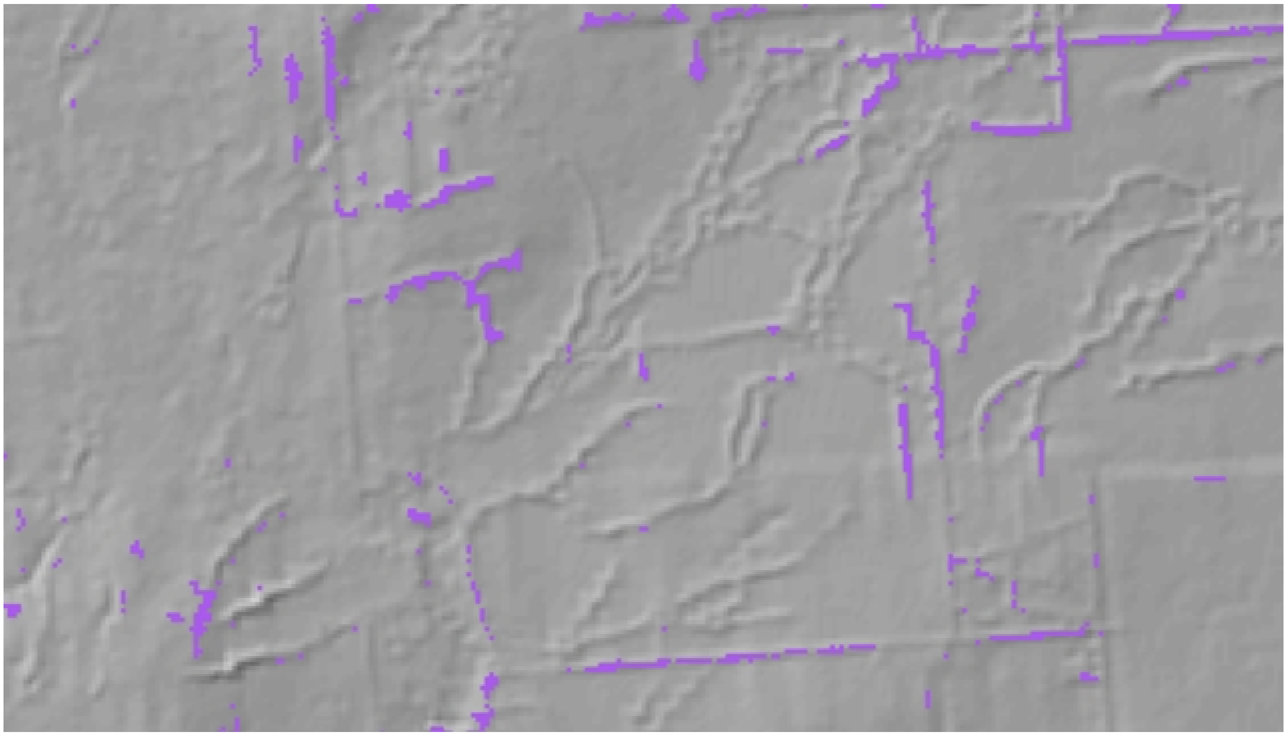


Figure 8. Final model, after clipping out streams on top of false ridges. Roads could not be clipped out without removing too much real potential.

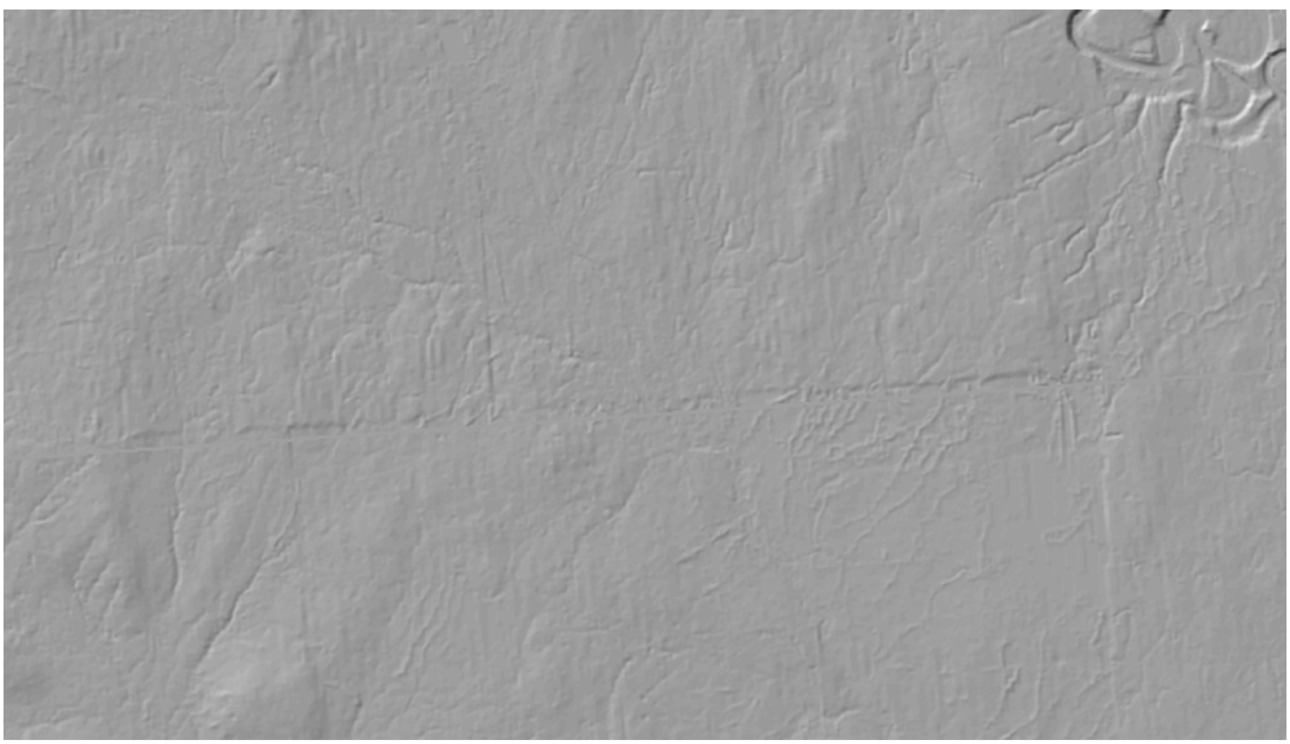


Figure 9. TRIM DEM tiling 'errors' can be seen in this hillshade as east-west and north-south lines.

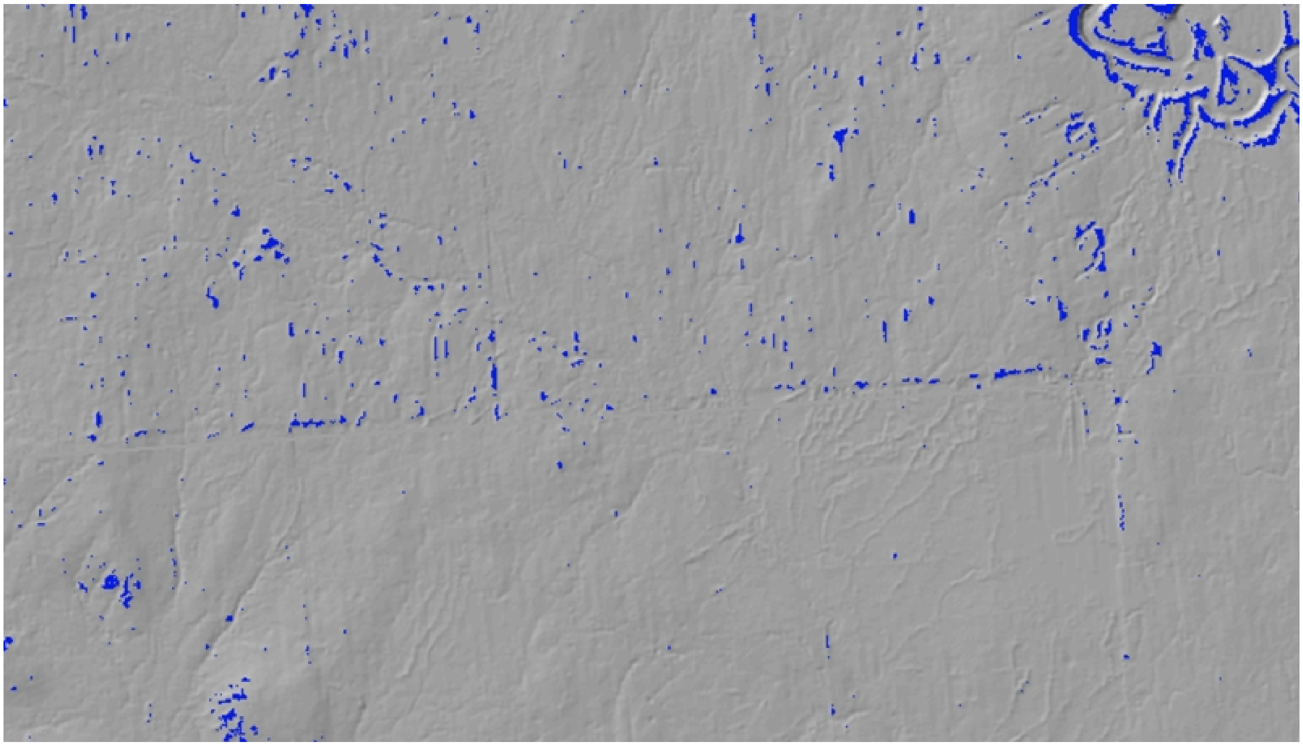


Figure 10. TRIM DEM tiling 'error' effect on model, as false terrace edge.

5.2.4 Image Classification

Image classification is a semi-automated process which classifies all of the pixels of a digital image based on their spectral characteristics, looking for patterns of colour or contrast for each pixel of the image and its neighbours. It is usually used to classify orthophotography into different land cover classes. For archaeological potential modelling, it uses the pattern of colour or shade in an area to imitate the human interpretation of orthophotos to identify high potential landforms, or vegetation typically correlated with high potential landforms. A manual approach has been used by archaeologists in the area to conduct development-specific potential assessment (e.g., Dahlstrom and Farvacque 2001). Image classification as a means of identifying archaeological potential was tested on a small scale for the Northeast BC AOA, and seemed to be performing quite well (Eldridge, et al. 2002). The classification matched most areas of potential that were hand-digitized onto orthophotos by an independent archaeological firm (not involved in the automated image classification work). For the current project, it was thought that image classification could improve the model, especially in the northernmost portion of the Peace Forest District, where the landscape is very flat and featureless in the TRIM, and potential is defined by features too small to be apparent in the TRIM DEM.

One of the northern, poorly performing TRIM model areas in mapsheet 94H, was used for an initial test image classification using a single colour orthophoto image. This test is described in Appendix E. The software requires an extreme level of computation and it was necessary to divide the single image into four subsets to avoid computer crashes or unreasonably long processing time. The initially promising results led to a decision to expand the test areas and continue image classification of the northernmost portions of the study area where the TRIM model was performing very poorly. Unfortunately, there were limited colour orthophotos available within the study area, and few of these were located in the northern mapsheets. Therefore, Timberline performed image classification on black and white orthophotos. This resulted in covering all of mapsheet 94I that is within the Peace Forest District, and the northern portion of 94H. In addition, image classification was performed in several other locations throughout the study area, where ground-truthing was to take place (Figure 11).

The black and white images were of varying quality. Some were clearly a mosaic of multiple images. This was evident by the mixed levels of image clarity, contrast, and different radial displacement directions (Figure 12). For some images, these issues were so severe that completely different results were obtained on different parts of the image, requiring the image to be clipped and classified as two or more separate data sets (Figure 13).

Trials were run to determine the most efficient method of classification. There are two types of classification: supervised and unsupervised. Supervised classification involves the manual digitizing of "training polygons" from which the software obtains the range of desired values that is then applied to the entire image, hopefully resulting in similar areas to the training polygons being classified into a single class (Figure 14). Supervised classification efforts were met with moderate success. However, in an effort to improve efficiency, unsupervised classification techniques were used for the bulk of the image classification. Unsupervised classification relies on the software to categorize the remotely sensed data into generalized groups. This method allows the software to identify the classes that are inherent in the data. After the classification was complete, the computer generated classes were grouped into two categories: potential and no-potential. This method was found to be as successful in identifying areas of potential as supervised classification efforts and considerably faster.

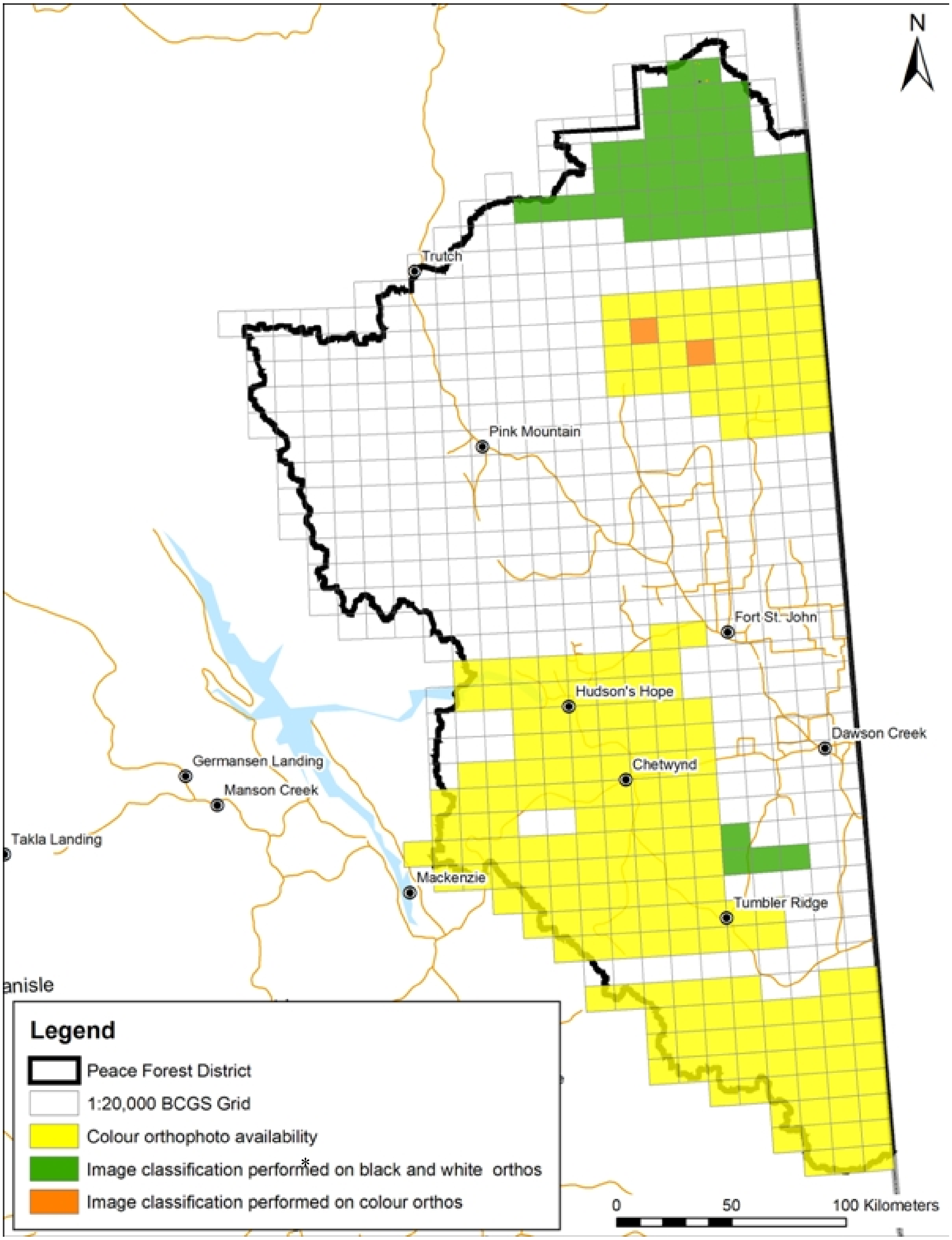


Figure 11. Locations of image classification*.
* Availability at time of image classification. A number of additional colour orthophotos for the region are now available.

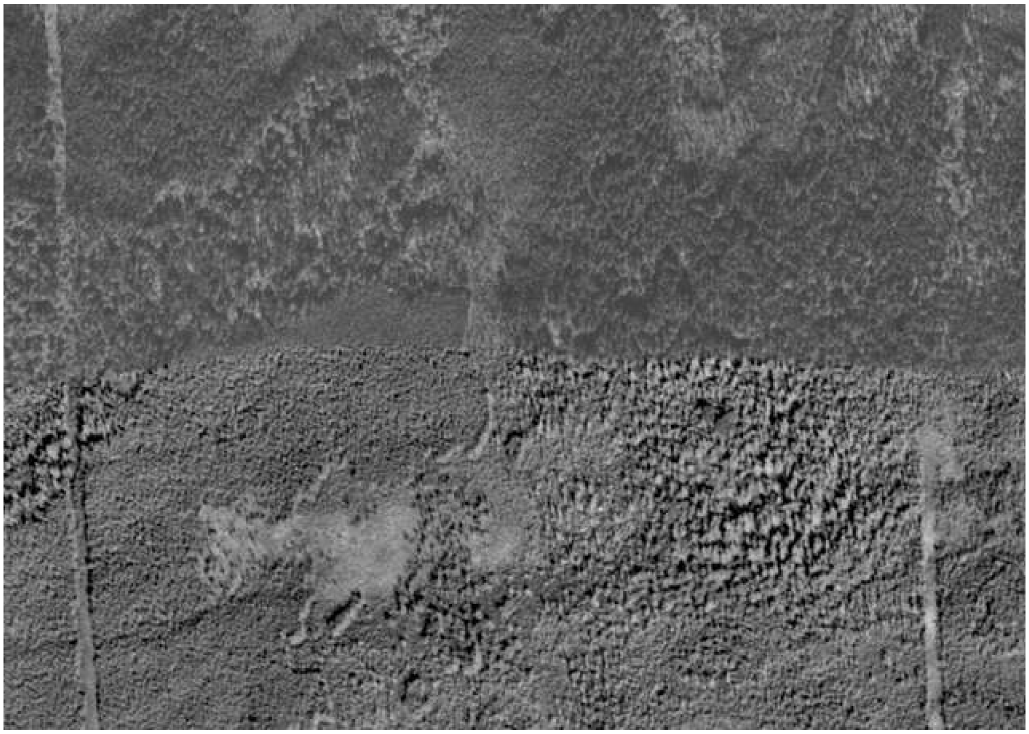


Figure 12. Example of "mosaicking" in an orthophoto. Note the difference in image clarity between the top and bottom of the image.

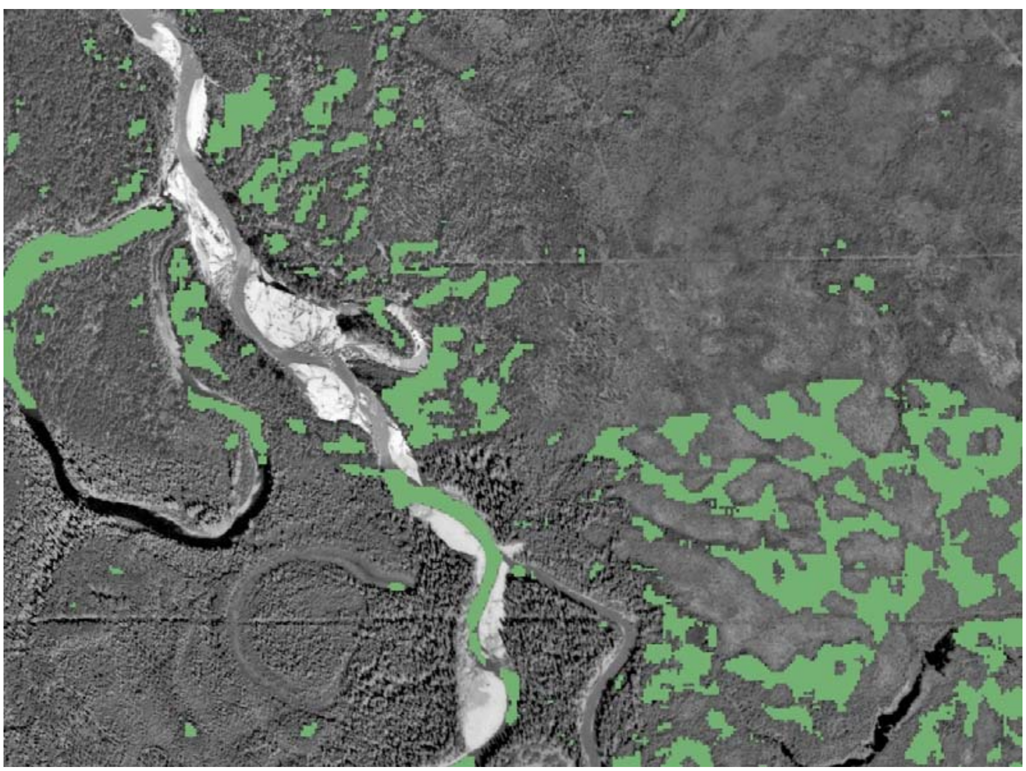


Figure 13. Initial classification of "high potential" (green) from a black and white orthophoto. Note that different parts of the image have very different results due to "mosaicking".

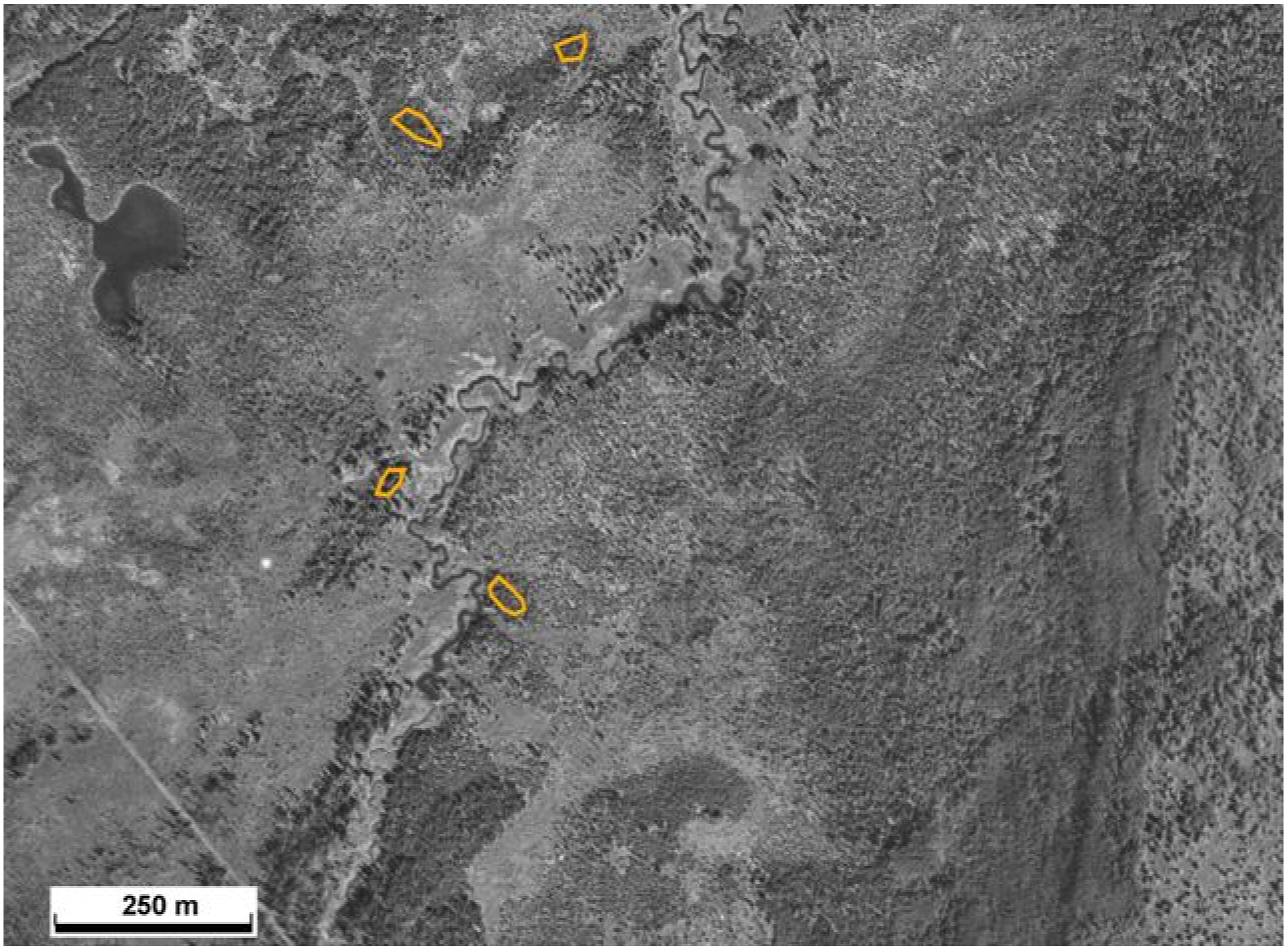


Figure 14. Example of training polygons for a supervised image classification.

After the classification was complete, the image was opened in ArcGIS. All of the pixels identified as potential were given a value of 1; all other pixels were given a value of 0. The neighbourhood statistics tool was then used to identify locations where potential was more concentrated.

Timberline provided Millennia with the image classifications which had been summarized by a 25 m window (based on 1 m cells). Each image was further classified to attempt to capture the high potential areas with the most accuracy and precision. This reclassification was initially converted to 25 m cells, in order to be able to integrate it with the rest of the model. The first round of ground-truthing was provided with the image classification model in this format. However, the results from the initial ground-truthing suggested that this may have excluded areas of potential, so the 1 m image classification was used for the later ground-truthing stages.

6.0 DOCUMENTARY RESEARCH AND CONSULTATION RESULTS

Documentary research included a review of ethnographic and archaeological literature (see Section 8.0). In addition, information pertaining to the ethnographic land use pattern and the pre-contact pattern suggested by the archaeological sites recorded in the Peace Forest District has been described in Sections 3.2 and 3.3 above.

However, it should be noted that the archaeological inventory for the study area has increased substantially in the last decade. Earlier, most archaeological sites were concentrated along the Peace River, a legacy of major inventory projects conducted for the original Site C hydroelectric project (Alexander 1982; Spurling 1978). Recorded sites elsewhere in the region were few and far between, although some of the first studies in BC relevant to uplands forestry were undertaken in the southern part of the region, partly as a response to the development of coal resources in the Tumbler Ridge region (e.g., Ball 1980; Stryd 1982). These studies showed that it was possible to find lithic scatters in forests with thick duff using systematic shovel testing. Other early research concentrated on the archaeological remains of the fur trade (Burley, et al. 1996). The current situation is far different; although a concentration of sites along the Peace River is still evident, sites are well distributed over the remainder of the region and the sample size is large, with over 3,000 sites now recorded in the study area (Figure 15).

The overwhelming majority of archaeological sites in the study area are small lithic scatters that probably represent a brief span of time and limited activity. Many likely correspond to locations where animals were butchered and processed and short-term camps were made. Deeply stratified sites from locations that were used over long periods of time are present, but rare. The best known site that represents a long continuum of occupation, with multiple occupation layers stratified in a fluvial terrace or fan, is HaRk-1, the Farrell Creek site (Spurling 1977).

6.1 Results of First Nation Studies

First Nations and aboriginal groups with an interest in the study area were consulted throughout the stages of model development. The intent in liaising with First Nations and aboriginal groups was to include the communities in development of the model by eliciting feedback on the current models and incorporating knowledge held by community members of areas which may have higher archaeological potential, such as travel routes and traditional camping areas. Groups who were contacted include: Blueberry River First Nations, Doig River First Nations, Fort Nelson First Nation, Halfway River First Nation, Kelly Lake Métis Settlement Society, McLeod Lake Indian Band, Prophet River First Nation, Saulteau First Nations, West Moberly First Nations and the Treaty Eight Tribal Association.

Meetings with interested communities were held for the project kick-off, and an outline of the proposed work was presented to Chief and Council or the lands department. While some communities did provide traditional knowledge locations within their territory, many communities indicated that they were concerned over the use of the information and its intellectual property. Communities that participated in the gathering of traditionally used areas included Blueberry River First Nation, Kelly Lake Métis Settlement Society and the McLeod Lake Indian Band. Interviews were held in the communities with members whose families have used resources in the study area for generations. The data collected was then incorporated into the model, with a buffer to provide for confidentiality. The rules of archaeological potential were lowered within the buffered areas to pick up more features on the landscape and create an area of higher archaeological potential.

First Nations and Aboriginal participants also took part in ground truthing the model with archaeologists from Millennia Research and Arcas Consulting Archaeologists. Communities that participated in the ground truthing include Blueberry River First Nations, Doig River First Nations, Halfway River First Nation, Kelly Lake Métis Settlement Society, McLeod Lake Indian Band and West Moberly First Nations.

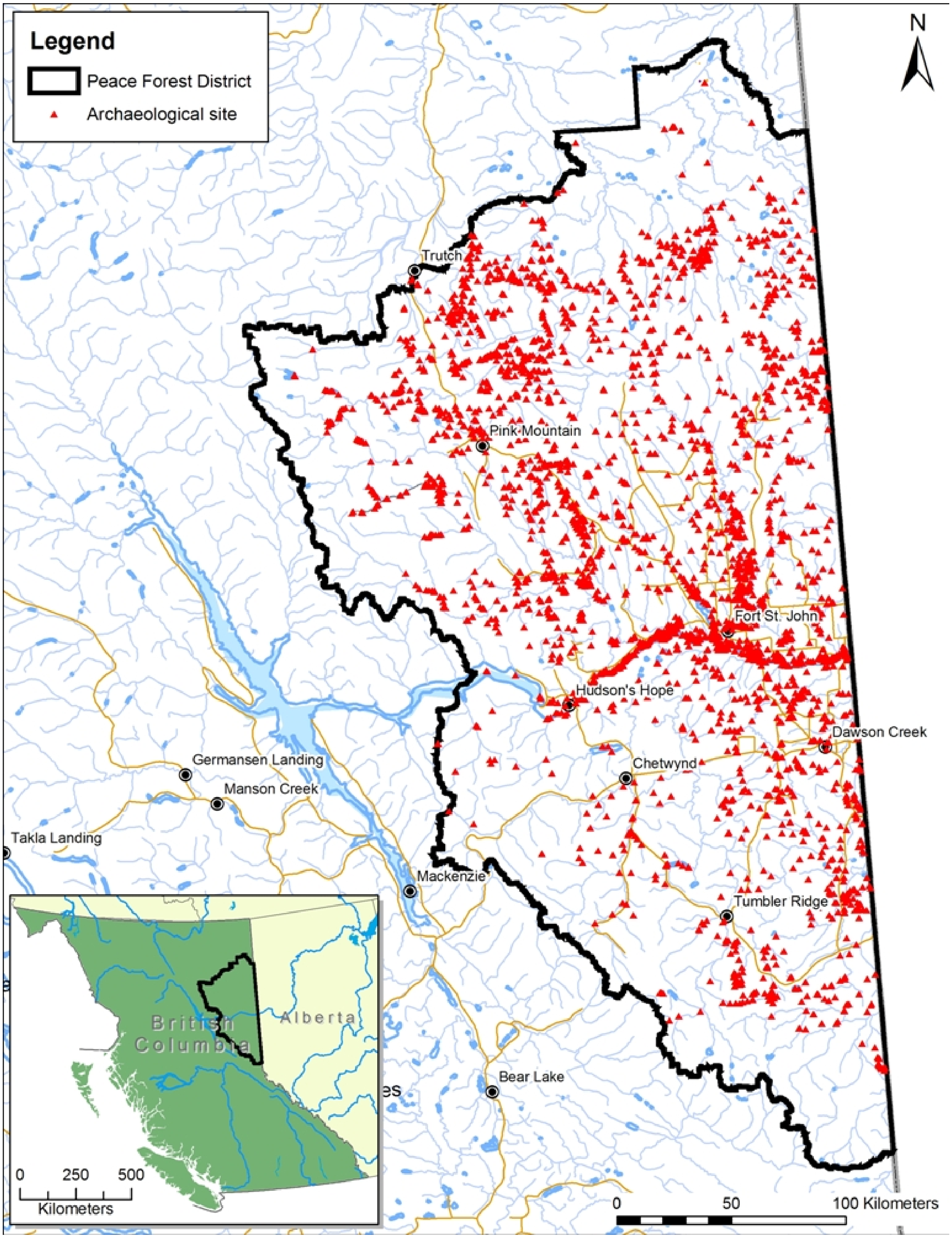


Figure 15. Recorded archaeological sites in the Peace Forest District.

7.0 MODELLING RESULTS

7.1 Peace Forest District Model Results

As mentioned above, the portion of the original model based on buffering water features was excluded from the final model following the initial ground-truthing. This ground-truthing data analysis concluded that the water portion of the model, while it does capture sites and areas of potential, is not, overall, a good indicator of potential. The ground-truthed high potential locations are related more to terrain features (e.g. knolls, ridges, terraces) and less with proximity to a water body. The water model may indicate higher potential for terrain features (i.e. a knoll close to a river, or a terrace overlooking a river would be higher potential than a knoll/terrace further away from a river), but does not seem to be in itself an indicator of potential. There are areas within the water buffer model that were ground-truthed as low potential, due to the lack of defined landforms. The detailed review of the initial ground-truthing results and discussion of the water features model is included in Appendix C.

Preliminary results showing that the terrain model worked well in more varied terrain, but poorly where terrain variation was limited, were confirmed by the ground-truthing. Therefore, the study area was broken up into two regions (see Figure 16). This was based on the elevation range over a window 500 m on a side. Region 1 consists of areas where the elevation range was greater than 75 m within this 500 m window, while Region 2 consists of areas where the elevation range was less than 75 m. This value was determined through testing a number of different values and determining which one most closely represented the actual break in model performance between the two regions. These regions were analyzed separately to determine final model performance in each. Model performance was measured using a couple of different methods. These methods include analysis of the ground-truthing data collected, comparing ground-truthing data to the model, as well as analysis of the number of recorded archaeological sites in the forest district that are captured by the model.

The ground-truthing points were compared to the model, by intersecting the points with the model. Where the points fell within the modelled area, they were assigned a model potential of "high", and a model potential of "low" where they did not fall within the modelled area. Four different results are possible:

1. High-high – The ground-truthed potential is showing as high, and the model potential is rated as high.
2. High-low – the ground-truthed potential shows as high, while the model potential is rated as low.
3. Low-high – The ground-truthed potential is showing as low, while the model potential is rated as high.
4. Low-low – The ground-truthed potential is showing as low, and the model potential is rated as low.

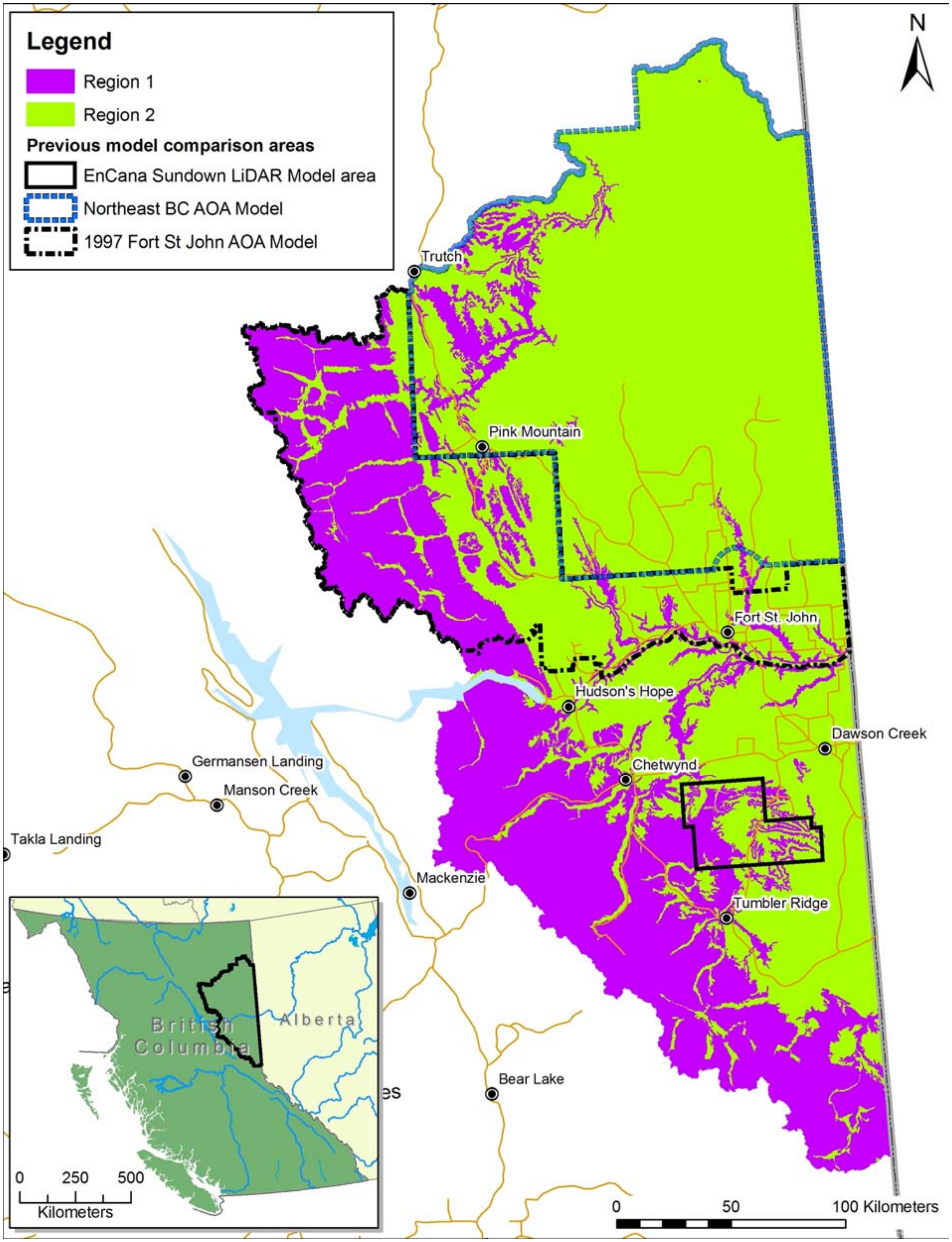


Figure 16. Peace Forest District AOA – Regions 1 and 2.

Scenarios 1 and 4 are the preferred "matching" cases, where the modelled potential matches the ground-truthed potential. Scenarios 2 and 3 are "non-matching" cases. The goal of modelling is to attempt to minimize the frequency of cases 2 and 3, and maximize the frequency of cases 1and 4. It would be impossible to have all 1s and 4s, and no 2s or 3s. This is due to the complex factors which determine potential, not all of which can be modelled. The results of this analysis were then tabulated for each ground-truthing area, and for the overall area. These detailed tables are included in Appendix F. Table 2 summarizes the percentage of ground-truthing matching and non-matching points by area. Note that the Low-Low result numbers are low – this sample could have been increased greatly if more waypoints had been taken in low potential areas.

Table 2. Ground-truthing results comparison to model

Ground-truthing Area	High-High	Low-Low	High-Low	Low-High
	% Matching points1		% Non-matching points2	
1	40	10.9	47.3	1.8
	51		***49***	
2	29.2	16.9	53.8	0
	46		***54***	
3	5.4	61.2	32.6	0.8
	67		***33***	
4	10.5	39.5	45.8	4.2
	50		***50***	
5	27.7	47.7	16.4	8.2
	75		***25***	
6	7.3	70	13.8	8.9
	77		***23***	
7	11.5	62.5	13.3	12.7
	74		***26***	
8	16.6	53.3	20.7	9.4
	70		***30***	
Overall	**64**		**36**	

In addition to analyzing the result of the ground-truthing, a comparison was made between the number of recorded archaeological sites captured by the model, and the amount of overall land area captured by the model. Two analyses were done using archaeological sites. The first was to

1 Matching points are where the ground-truthed potential matches the modeled potential – this includes two options, where the ground potential is high and the modeled potential is high (High-High), or where the ground truthed potential is low and the modeled potential is low (Low-Low).
2 Non-matching points are where the ground-truthed potential does not match the modeled potential – this includes two options, where the ground potential is high and the modeled potential is low (High-Low), or where the ground truthed potential is low and the modeled potential is high (Low-High).

determine the number of sites whose boundaries intersected the model. The second was to buffer the sites by 25 m and then determine how many of the buffered sites intersected the model. This second method was to account for the likelihood of sites being misplotted by at least 25 m. The sites were then categorized according to whether their center point was in Region 1 or Region 2 (the center point was used to account for those that might overlap both regions).

The area of land modelled in each region was also calculated, in order to evaluate model performance using Kvamme's Gain Statistic referred to as Kv gain (Kvamme 1988), which is a statistic to measure the performance of a model based on comparing the ratio of the percentage of archaeological sites captured to the overall land area captured by the model. The formula for Kv gain is:

$$\text{Kv gain} = 1 - \left(\frac{\%\ \text{land captured}}{\%\ \text{sites captured}}\right)$$

A high Kv gain, (to a maximum of 1.0) is indicative of a good model where the number of captured sites is very high and the area of land modelled is very low. A low Kv gain is indicative of a poorly performing model. A Kv gain of around 0 suggests that the model is performing no better than random, and a negative number indicates worse than random. A Kv gain of 0.8 or better generally indicates a non-random, highly predictive model and is the Archaeology Branch standard for Archaeological Overview Assessments (2009). As relates to models, the standards provide minimum acceptable performance ratings, using both the Kvamme's Gain Statistic and the percentage of sites in the study area that are captured by the model. The standards state that at a minimum, a model must have a Kv gain of at least 0.8 **and** a site capture of 70% of recorded sites in the study area, in order to be accepted by the Branch.

Table 3. Model results using capture of recorded archaeological sites.

Region	% sites captured (unbuffered)	% sites captured (using 25 m buffer)	% land captured	Kv Gain (using buffered site capture %)
1	52.1	69	9	0.87
2	25.2	38.5	6.9	0.82
Overall	**29**	**42.8**	**7.7**	**0.82**

Region 1 therefore, just meets the Archaeology Branch standards. While it has a fairly high Kv gain, it is just at (actually a single percentage below) the 70% site capture requirement. However, in light of the fact that a number of the archaeological sites in the forest district are misplotted by more (sometimes much more) than 25 m, and that there are many whose locations can not be identified with any great certainty, the model performance is probably better for both Kv gain and percentage captured..

Two other analyses were performed to assess model performance. One consisted of limiting the archaeological site sample to sites which had been recorded using a GPS unit (based on analyzing the "Accuracy" and "Accuracy Remarks" fields of the Provincial site database) and had been inventoried from 2007 onwards (to reflect the great improvement in technology in the past few years that allows sites to be mapped with much higher accuracy). This subsample was checked to confirm site accuracy. This was done by picking sites at random and downloading the site map which had been submitted with the siteform, then comparing the mapped location on the site map with the mapped location in the GIS. Orthophotos, mapped roads, seismic, oil and gas facilities, water features, and the digital elevation model were all used to check that the site location mapped in the GIS matched that shown on the site map. With a very few exceptions, this subsample of sites were found to be quite accurately mapped, so was used to re-test the model (Table 4). Out of over 3000 sites in the forest district, only 514 fell within the requirements to be included in the sample. These are all newly recorded sites that were not used to build the model; they are therefore an independent test sample. Normally, models will perform better on the sample used to build the model than they will on independent test data (Kamermans, et al. 2009; Verhagen 2007). It is significant, and perhaps due to increased accuracy of GPS, that the independent sample has better performance than the data used to build the model. Of the newly recorded sites, only 72 sites were located in Region 1; the remaining 442 were located in Region 2.

Table 4. Model results using capture of a sample of accurately mapped archaeological sites.

Region	% sites captured (unbuffered)	% sites captured (using 25 m buffer)	% land captured	Kv Gain (using buffered site capture %)
1	74	81	9	0.88
2	28	41	6.9	0.83
Overall	**34.2**	**46.5**	**7.7**	**0.83**

These numbers are clearly an improvement on the results for all inventoried site locations, though Region 2 remains well below the Archaeology Branch standards for site capture. The statistics for Region 1 have improved to a point that it meets the Archaeology Branch standards even without using the 25 m buffer.

In addition to archaeological sites, the ground-truthing data may be used to calculate the Kv gain. Essentially, all points ground-truthed as “high” potential in the field may be used as a stand-in for archaeological sites, even if no sites were found at those locations as the intent of the model is to identify potential for sites, whether or not there is an archaeological site there. The results are similar to, but not as good as for actual sites; perhaps the ground-truthing points tended to overemphasise potential.

Table 5. Model results using capture of ground-truthed "high" potential points.

Region	% ground-truthing points captured (unbuffered)	% ground-truthing points captured (using 25 m buffer)	% land captured	Kv Gain (using buffered point capture %)
1	59.2	68.2	9	0.87
2	29.3	41.8	6.9	0.83
Overall	**35**	**47**	**7.7**	**0.84**

7.2 Comparison with previous models applicable to the Peace Forest District

The new model was compared to three previous models which cover portions of the study area. These are the EnCana Sundown LiDAR model (Millennia Research Limited 2004), the Northeast BC AOA (NE AOA) model (Eldridge and Anaya 2005) and the Fort St John Forest District (FSJ) model (Mackie 1997). The comparison was performed by selecting sites and ground-truthing points within these model areas, and doing the same analyses using these older models as were used for the current model. The results of the analyses of the NE AOA and the 1997 FSJ model are presented in Table 6. The comparison with the EnCana LiDAR model is described separately in more detail below.

Table 6. Previous model comparison

Model	% sites captured (unbuffered)	% sites captured (using 25 m buffer)	% land captured	Kv Gain (using buffered site capture %)
Current Model Region 1	52.1	69	9	0.87
Current Model Region 2	25.2	38.5	6.9	0.82
NE AOA	27.5	38.6	11	0.72
1997 FSJ – High Potential	69	80	37	0.54
1997 FSJ – High & Moderate Potential	92	95	89	0.06

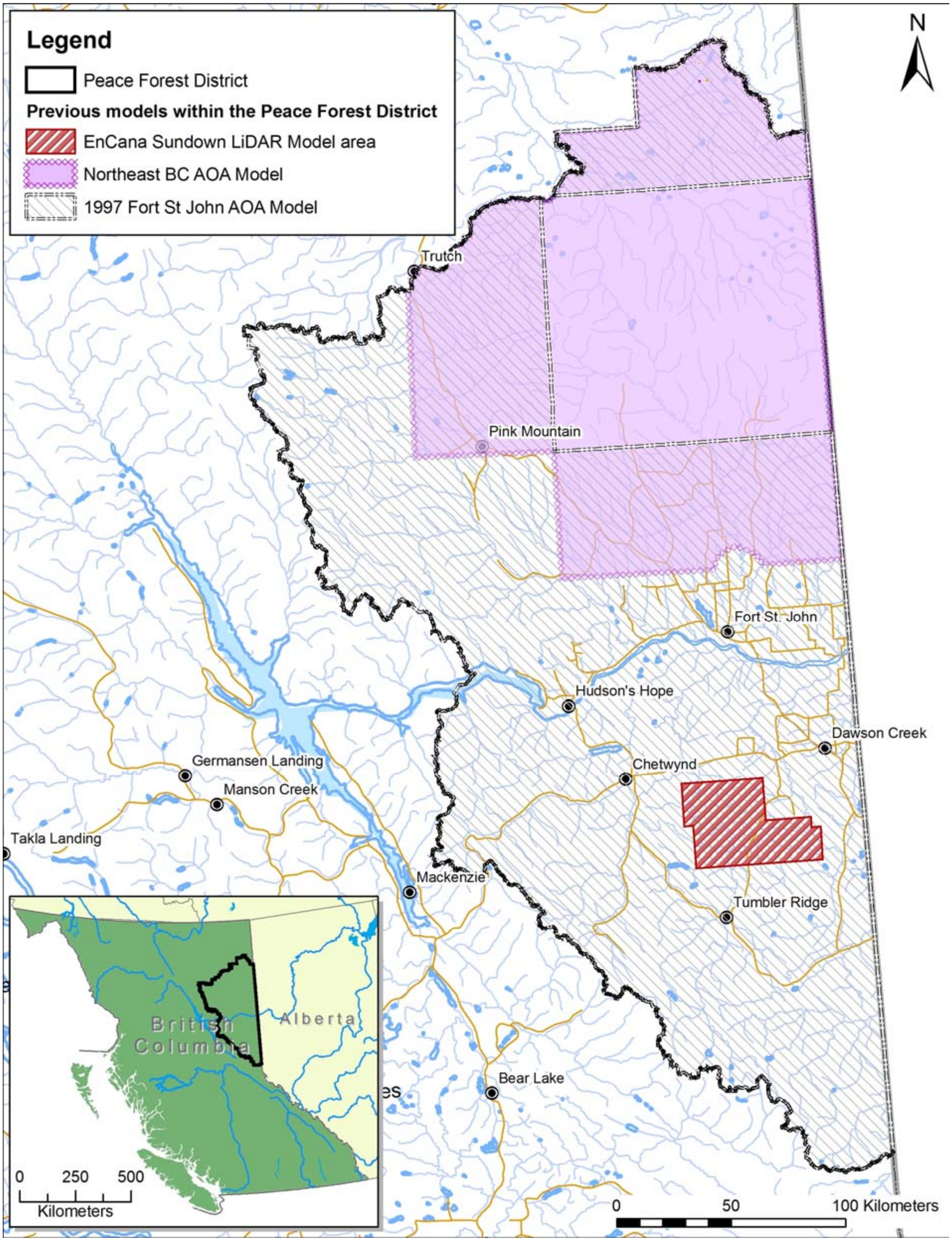


Figure 17. Previous models within the Peace Forest District.

The new Peace Forest District model certainly improves on older models in the area. Both of these previous models overlap only a portion of the current study area; the 1997 FSJ model spans, approximately equally, Region 1 and Region 2, though moderate potential areas are concentrated in Region 1 and high potential areas are concentrated in Region 2. The NE AOA model overlaps primarily Region 2. However, even if Region 2's statistics for the new model are compared (and not the overall statistics), the new model still improves considerably over the older models. Though the 1997 FSJ model captured a higher number of sites, it also captured much higher land area, for a poor Kv gain.

7.3 LiDAR-TRIM Comparison

Within the study area is a smaller region where Millennia had created an archaeological potential model based on LiDAR data, for EnCana Corporation (EnCana). Upon request, EnCana graciously granted permission to use this model for comparison to the Peace FD TRIM-based model. The area for which the LiDAR model is available was added to the ground-truthing areas, so that an in-field comparison of both the TRIM and LiDAR models could be performed. The results of this comparison are detailed below.

This area was ground-truthed in March 2009, while there was still moderate snow cover making ground-truthing more difficult; in spite of this and some very cold temperatures, the field crew were able to collect over 500 ground-truthing observation points. This data was then used to check the two different models. Because of the high resolution of the LiDAR modelling (5 m cell size), all of the GPS waypoints were checked against the field notes and LiDAR-derived hillshade and 50 cm contours to ensure that they correctly represented the ground features. Standard GPS error for the hand-held Garmin GPSMap 76Cx and 60Cx units used is approx ± 5 m (which varies depending on tree cover, satellite configuration etc.) This means that the waypoint may not fall directly on the feature being targeted. As well, due to weather conditions and safety concerns, some observations were made from the vehicle, so the waypoint was made on the road, but was referencing a feature visible off the side of the road. These waypoints needed to be manually shifted to the appropriate landform.

All waypoints in the area were checked using field notes as a guide to ensure that the potential ratings were correctly represented. In some cases, the feature targeted could not be adequately identified from field notes, so its capture/non-capture by the models could not be verified. In these cases, the points were excluded from the statistics to prevent incorrectly weighting the sample one way or the other. Likewise, notations of "moderate" potential were checked. The field investigators sometimes encountered features with some potential that they would test if time allowed (especially in a summer test situation) but would not bother with if time was short. If the notes indicated that the feature would likely be shovel tested, or that the potential was "moderate-high", or if similar surrounding features were rated as high and the notes indicated that the feature was similar to the surrounding features, the potential rating was changed from "moderate" (which can't be used to test the model, as the model doesn't contain a moderate potential layer) to "high". Conversely, if the notes indicated no shovel testing would be likely to be done on the feature, or otherwise indicated relatively lower potential, the rating was changed to low. Points for which the rating could not be determined to be either "high" or "low" were left out of the statistics.

There were various cases of the LiDAR model showing high potential where ground-truthing showed low potential. Some of these were ground-truthed as low potential due to ground disturbance activities, or due to the surrounding features and terrain such as the proximity of higher potential features (e.g., it was a relatively level, well drained feature, but there were level, very well drained features a metre or more higher elevation a short distance away). The LiDAR model frequently captures man-made features with characteristics similar to the natural features we are trying to model for, such as road berms and borrow pits (Figure 18). To account for this "false" potential, the number of "high-low" (model potential – ground-truthed potential) points within a 40 m buffer on either side of the road was calculated. At least 60 points were in this category, and there may be more where road mapping is not available, or where there are borrow pits or other man-made landforms.

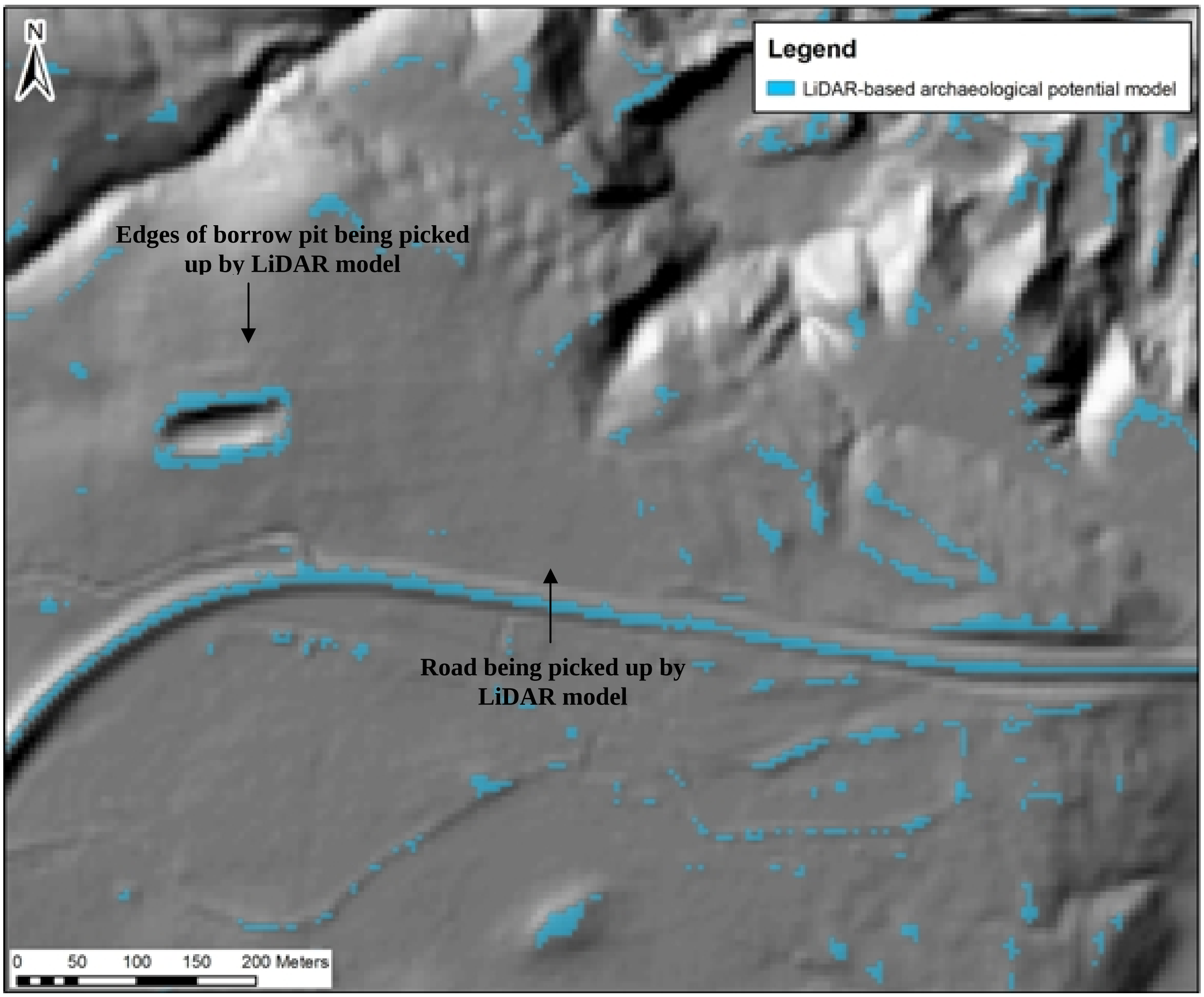


Figure 18. LiDAR model picking up man-made features: roads and edges of borrow pit.

When the ground-truthing results are compared to the LiDAR model, all four possible results are represented: High-High, High-Low, Low-High, and Low-Low (Figure 19). Table 7 summarizes the results of the comparison:

Table 7. Results of ground-truthing compared to LiDAR model

LiDAR Model Potential	Ground-truthed Potential	# waypoints	Total # waypoints	% total
High	High	292	567	51.5
High	Low	161	567	28.4
Low	High	25	567	4.4
Low	Low	89	567	15.7
% Matching (High-High, Low-Low)				67.2
% Non-matching (High-Low, Low-High)				32.8

These results are good – over two thirds of the ground-truthing points match the LiDAR model. However, the results improve if the 60 points that are **road berms** captured by the LiDAR model are removed from the High-Low column and added to the Low-Low column; the % matching goes up to **78%**, and the non-matching down to **22%**. This reflects what the LiDAR model would show were roads buffered then clipped out of the model to remove this false potential. This would be feasible using the LiDAR model where it is not using the TRIM model, due to the coarseness of the cell sizes (see above). At other Low field-High model locations, there was a microtopographic landform, but researchers determined that it had lower potential (often these were the ones field labelled 'moderate' potential).

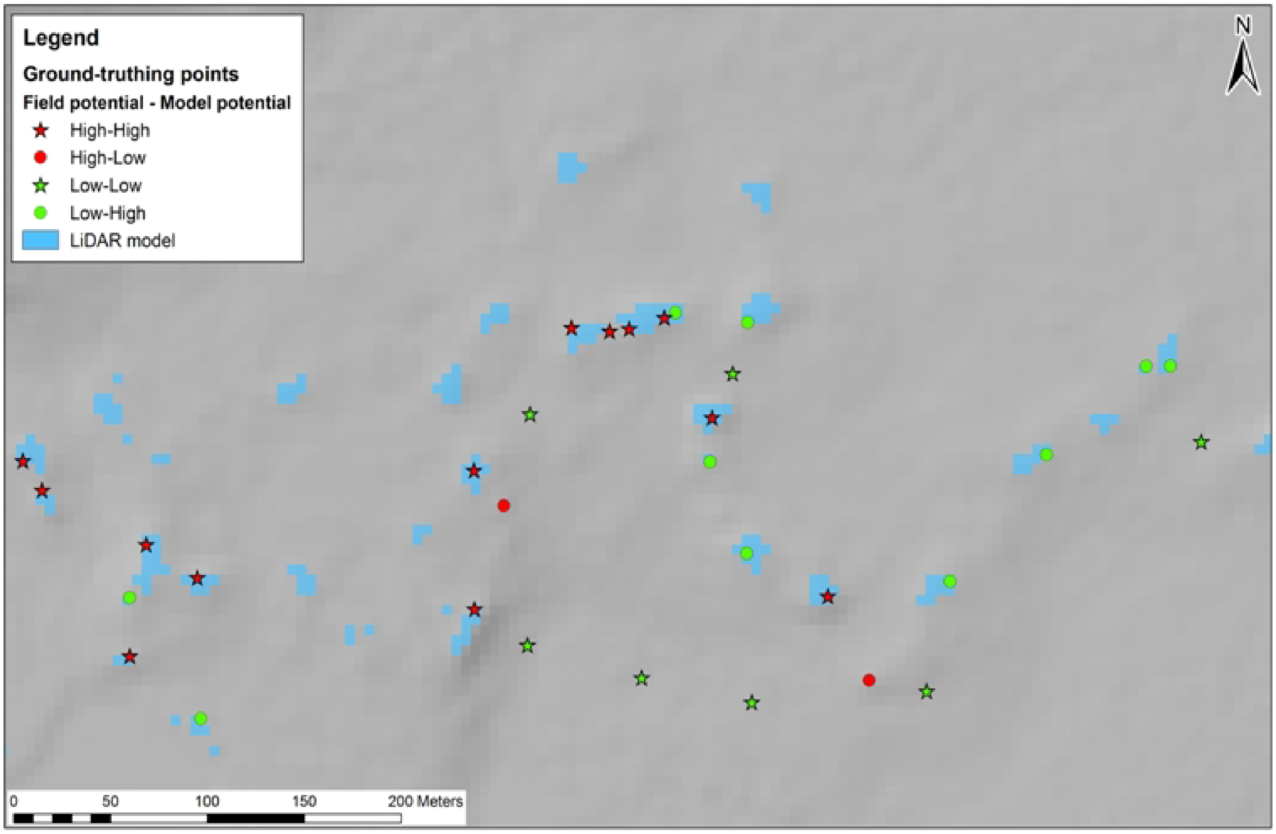


Figure 19. Example of ground-truthing potential rating compared to LiDAR model.

In some places, the LiDAR model matched ground-truthing ratings perfectly (Figure , excluding the linear strips of potential along the highway).

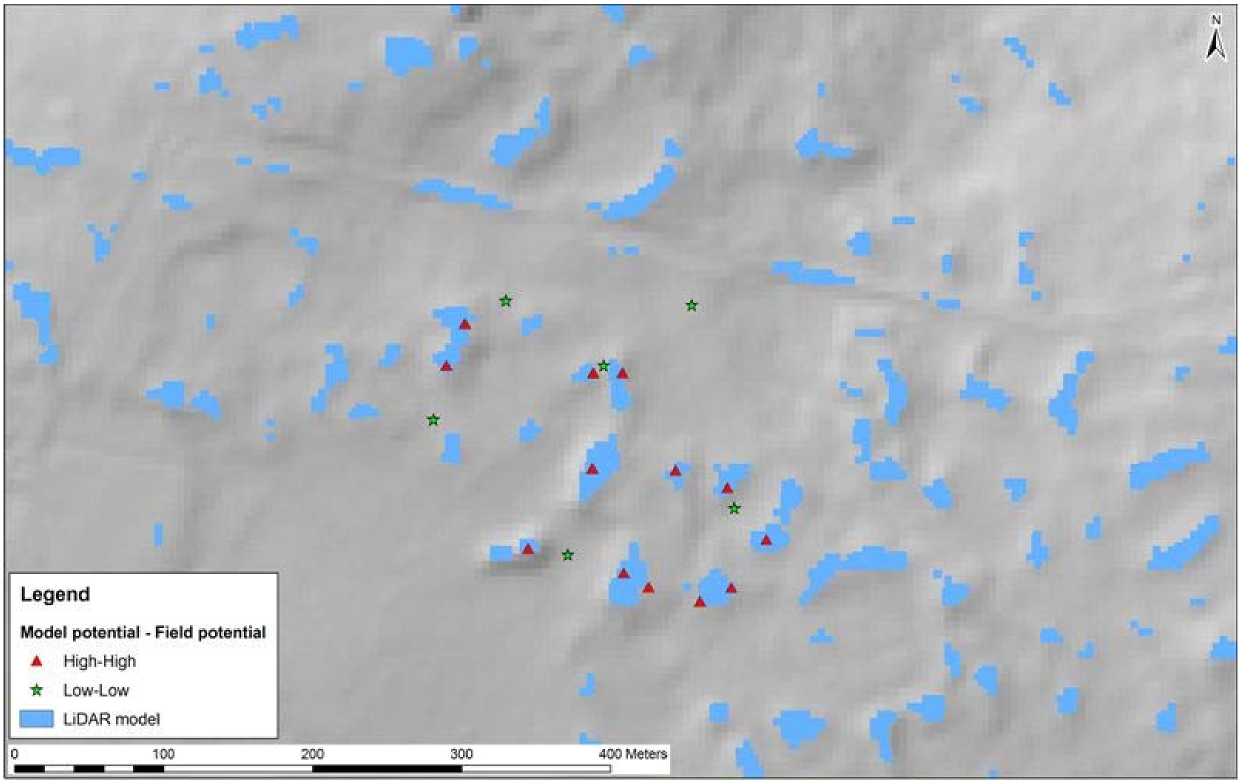


Figure 20. Example of matching ground truthing potential rating compared to LiDAR model.

The TRIM model comparison to the ground-truthing also resulted in all four possible options (Figure 21), which are summarized in Table 8:

Table 8. Results of ground-truthing compared to TRIM model

TRIM Model Potential	Ground-truthed Potential	# waypoints	Total # waypoints	% total
High	High	28	567	4.9
High	Low	8	567	1.4
Low	High	289	567	51.0
Low	Low	242	567	42.7
% Matching (High-High, Low-Low)				47.6
% Non-matching (High-Low, Low-High)				52.4

A comparison with Table 7 shows a huge increase in performance with the LiDAR data. Many of the 'missed' locations where ground potential rated high and the model rated low were immediately beside modeled high potential, on the same landform (see Figure 19). There was one very well defined small but high landform that was assessed as having very high potential but that was not captured by the EnCana LiDAR model. As expected, examination of the data showed that the top of this landform was split into four quadrants by the 5 m model grid. Each cell had a slope calculated as being too steep for inclusion, although the actual feature top was level and ca 8 m square, with a larger area of modest slope surrounding it. The parameters of the model were examined and it was found that such features could be included by a combination of count, positive, and slightly higher slope. The revised model then captured this and a number of other features not previously captured by the model, yet the increase in captured land area over the initial model was a miniscule 0.01%. This type of 'model tweaking' based on ground-truthing results is highly effective.

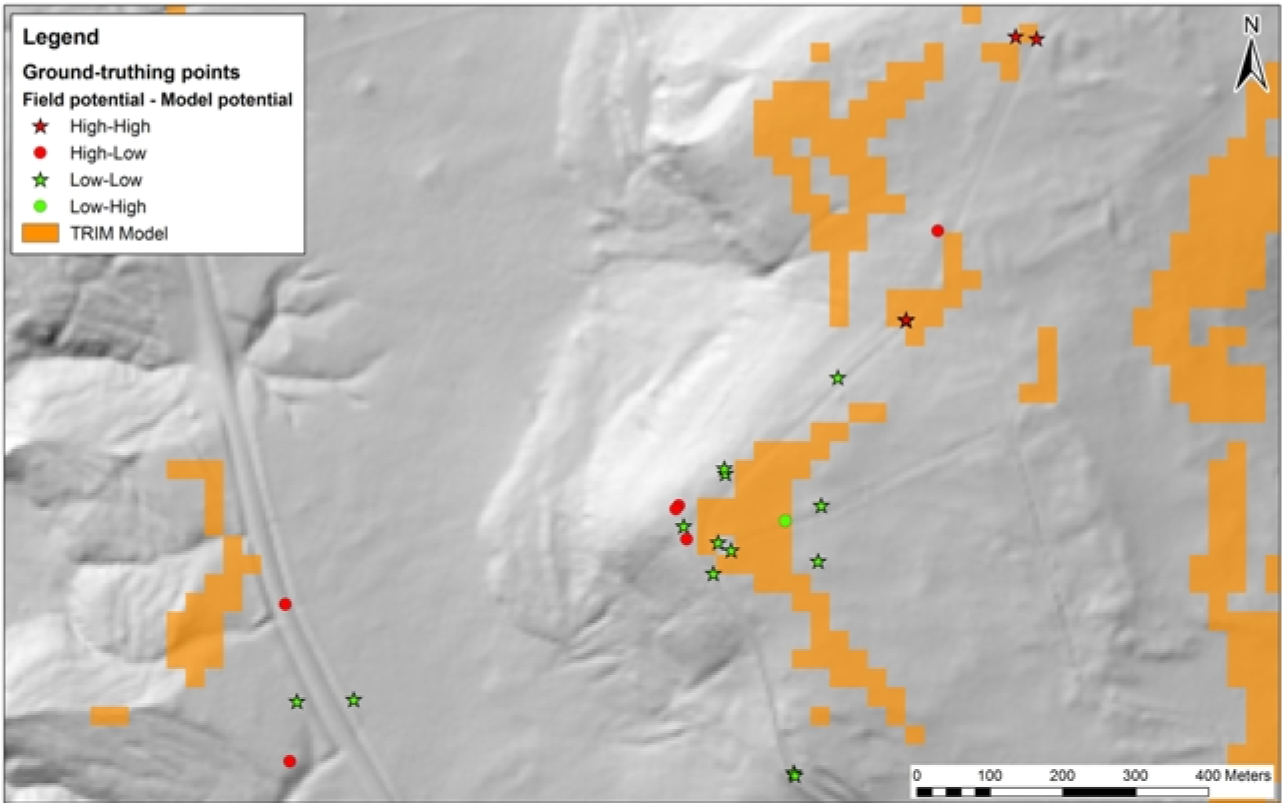


Figure 21. Example of ground-truthing potential rating comparison to TRIM model (LiDAR hillshade). Note that some of the high potential locations are just outside the TRIM model potential, but obviously refer to the same landform; in these cases, the TRIM indicates the presence of a landform that may be larger in reality.

Further analysis of the performance of both the LiDAR and TRIM models in this location was done by comparing the locations of recorded archaeological sites within the area to the model. Where the sites intersect a modelled area, they are considered "captured" by the model. This requires the sites to be mapped accurately to get an accurate representation of model performance. As part of the development of the EnCana LiDAR model, Millennia had checked site location mapping, and, where possible, moved sites that were incorrectly mapped to the correct location. Most of the sites were shifted at least 5 meters from their mapped location, and some were moved greater distances. The highly detailed LiDAR DEM was invaluable in locating the correct position of the sites; without LiDAR data, many of the sites could not have been corrected. To prevent bias from influencing the site location correction, the model was not referenced while correcting sites. Only after the sites had been corrected were their locations compared to the LiDAR model. Out of the 35 inventoried sites in the area, 29 were captured by the LiDAR model. Those not captured fell into a couple of different categories. Three sites could not be revised or confirmed due to inadequate field mapping or conflicting location information, while two sites were noted to have been destroyed. Only one site that was correctly mapped was not captured by the model. This particular site was not associated with any microtopographic landforms and this was explicitly stated in the siteform. If the five destroyed or unconfirmed sites are excluded from performance analysis, the LiDAR model captures 29 out of 30 sites, a 97% capture rate.

As of March 8, 2010, an additional nine sites had been added to the inventory of the LiDAR model area since the original analysis was completed. All nine were caught by the model; raising the total to 38 of 39 sites (the percentage is virtually unchanged, rounding to 97%). This data, even more than the ground-truthing points, constitutes an independent sample of the *prediction* of archaeological sites; using the inventoried sites is a *retrodiction* and model performance is likely to be artificially inflated from testing against the data used to create it (Kamermans, et al. 2009; Verhagen 2007).

For appropriate comparison, the TRIM model was clipped to the area of the LiDAR model, and the same original set of 35 sites that were compared to the LiDAR model were then compared to the TRIM model. If the five destroyed and unconfirmed sites are left out of the sample (as for the LiDAR model comparison), a total of seven sites are captured by the TRIM model. The single site not associated with microtopographic landforms was captured by TRIM model, but not by the LiDAR model. This results in 23% (7/30) of the sites captured by the TRIM model.

The ground-truthing points that were field rated as “High” can also be used as if they were sites, to increase the sample used to test the model’s performance. There are a total of 317 “High” rated ground potential points. Of these, the LiDAR model captures 292 (92%) while the TRIM model captures 28 (9%). The resulting Kv gain statistics were calculated for each of sites, ground-truthing points, and then for a combination of the two (treating each “high” ground-truth point as a single site) (Table 9).

Table 9. Comparison of LiDAR and TRIM models using Kv Gain.

Model	Sample type	% captured	% land captured	Kv Gain
LiDAR	Ground-truthing points	92	1.6	0.98
	Sites	97		0.98
	Combined	93		0.98
TRIM	Ground-truthing points	9	5.2	0.42
	Sites	23		0.77
	Combined	10		0.48

These results on the LiDAR modeling produce the highest Kv Gain scores the authors are aware of. Gains of 0.6 and 0.7 with 60% of the sites captured are common and model researchers have long been working to improve the trade-off between accuracy (capturing a large percentage of sites) and precision (not capturing a large amount of land) (Kamermans, et al. 2009). With this LiDAR model we have simultaneous very high accuracy and and very high precision. The Kv Gain of this and another NE LiDAR model by Millennia were commented on by Dr. Philip Verhagen (2010, personal communication), a European expert on predictive modeling:

> *“Yes, these must be record scores, no doubt! The best gains that I know of in the US are in the order of 0.7 to 0.8 (the model reported by Tom Whitley et al. at*

CAA2009 for example achieves 0.8065), and in Europe it's usually even lower than that. It seems however that Canada may be a special case; Terry Gibson reported a gain of 0.906 for a model made for the Alberta boreal forest (Gibson 2005 in Van Leusen et al.).”

The LiDAR produced results that were clearly superior to the TRIM based modeling, but LiDAR is not available for the entire study area. In an effort to improve the accuracy and precision of the TRIM based model, image classification was examined in detail.

7.4 Image Classification Results

Preliminary image classification appeared to perform quite well, and initial ground-truthing suggested it was capturing high potential landform features too small to be captured by the TRIM terrain model (see Appendix E for details). Subsequent image classification results are not as promising. In addition to the poor results from ground-truthing, the image classification of a large set of orthophotos presented several issues that had to be dealt with. One of the primary issues, discussed briefly above, is the “mosaic” effect, where two parts of the same image will be of differing contrast quality or have different radial displacement. Another issue is that, as the images were black and white, there were frequent difficulties in distinguishing between dark water, shadow and the densely treed areas associated with archaeological potential. Also, different terrain has different “signatures” for defining archaeological potential, requiring a careful on-screen visual analysis of each orthophoto and the classification of potential, to ensure that archaeological potential in each image is correctly classified, a time-consuming task.

While in some cases the classification appeared to work well, many small knoll features could not be identified in the orthophotos due to lack of vegetative clues. A more detailed, colour orthophoto may indicate more of these features that have high potential for archaeological sites, but will always miss some of these areas, where the vegetation appears unchanged but the terrain does in fact change. Cases of the opposite were also observed during ground-truthing, where the vegetation changes but there is no evidence of a terrain change, or the terrain change is so minor as to not be considered significant.

Additional difficulties were observed when a test area of image classification was performed in the southern 93P letter block. In the northern portion of the forest district, archaeological potential was identified by vegetation changes (e.g. the presence of aspen and lodgepole pine). However, unlike the areas that were classified in the north, the southern region of the study area is dominated by broad expanses of forest (Figure 24). This made distinguishing areas of archaeological potential (chiefly areas that represented changes in elevation that could not be detected by the TRIM digital elevation model) very difficult. In the north, patches of vegetation stood out on the landscape and could be used as surrogates for landforms and therefore AOA potential; this, however, was not possible in the southern region, where there were few spectral differences across the landscape.

Large areas of the southern images were covered with trees which had no variations within them to indicate possible landforms and archaeological potential. While it was possible to pick out the definitely low potential (muskeg) areas, there were huge areas, containing recorded archaeological sites, which were impossible to differentiate. The image classification model was indeed picking up some of the features we wanted to capture (in particular, small areas of trees surrounded by muskeg, which would most likely indicate a topographic rise in the flat) but it was also capturing large areas of undifferentiated terrain (Figure and Figure). This issue does not only occur in the southern portion of the forest district; while it was less prominent, the same issue was observed in the northern image classification areas as well. Figure 25 shows a location in the northern image classification area where ground-truthed potential matched the image classification, but to the west of that location, a relatively broad expanse of undifferentiated vegetation is captured by the model. Figure shows a location where the image classification is performing poorly; three ground-truthed low potential locations are being modelled as high potential by the image classification.

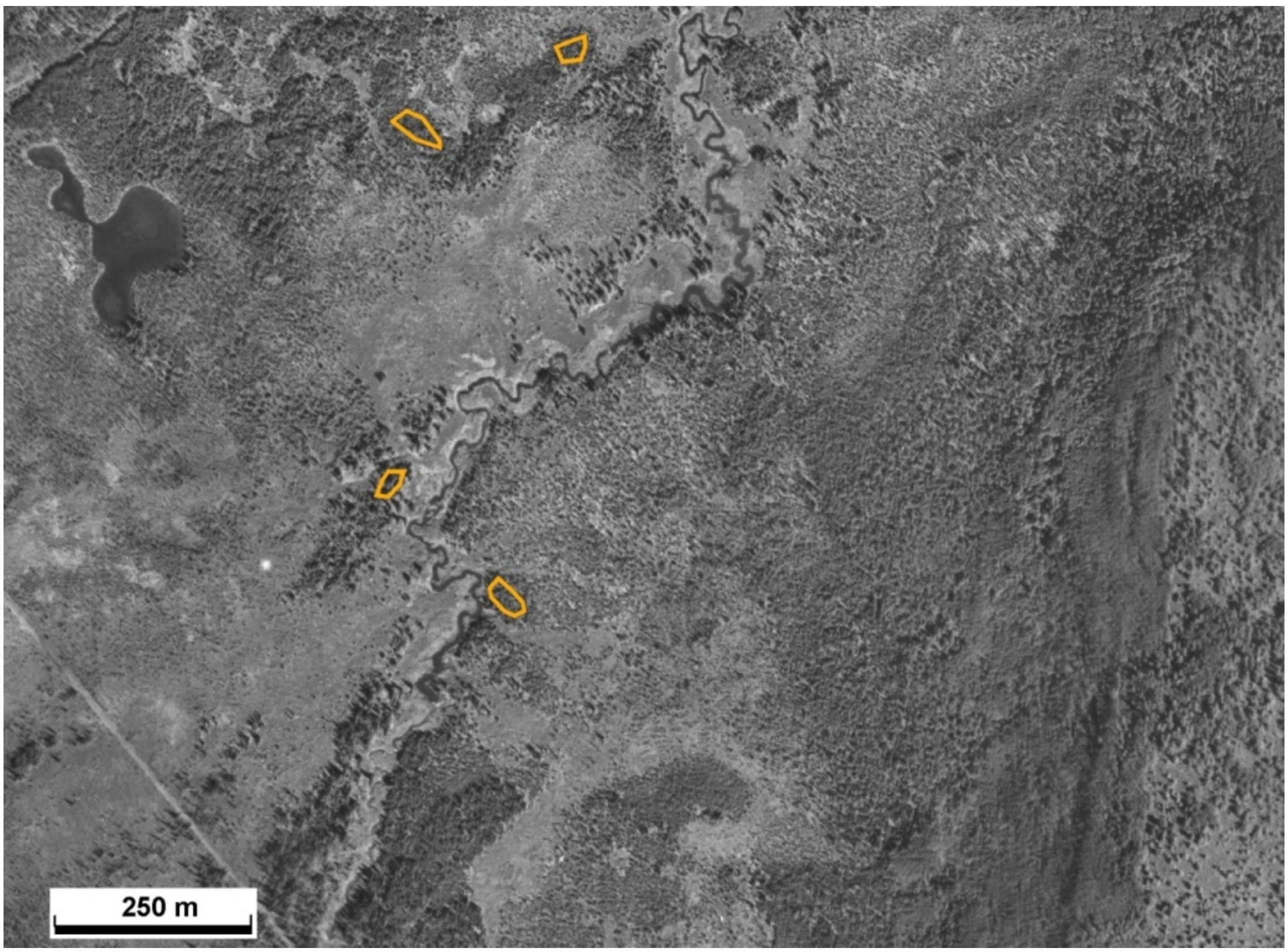


Figure 22. Example of area in southern portion of study area where image classification was performed. Orange polygons note locations that were considered as likely high archaeological potential, and were used as training polygons for the image classification.

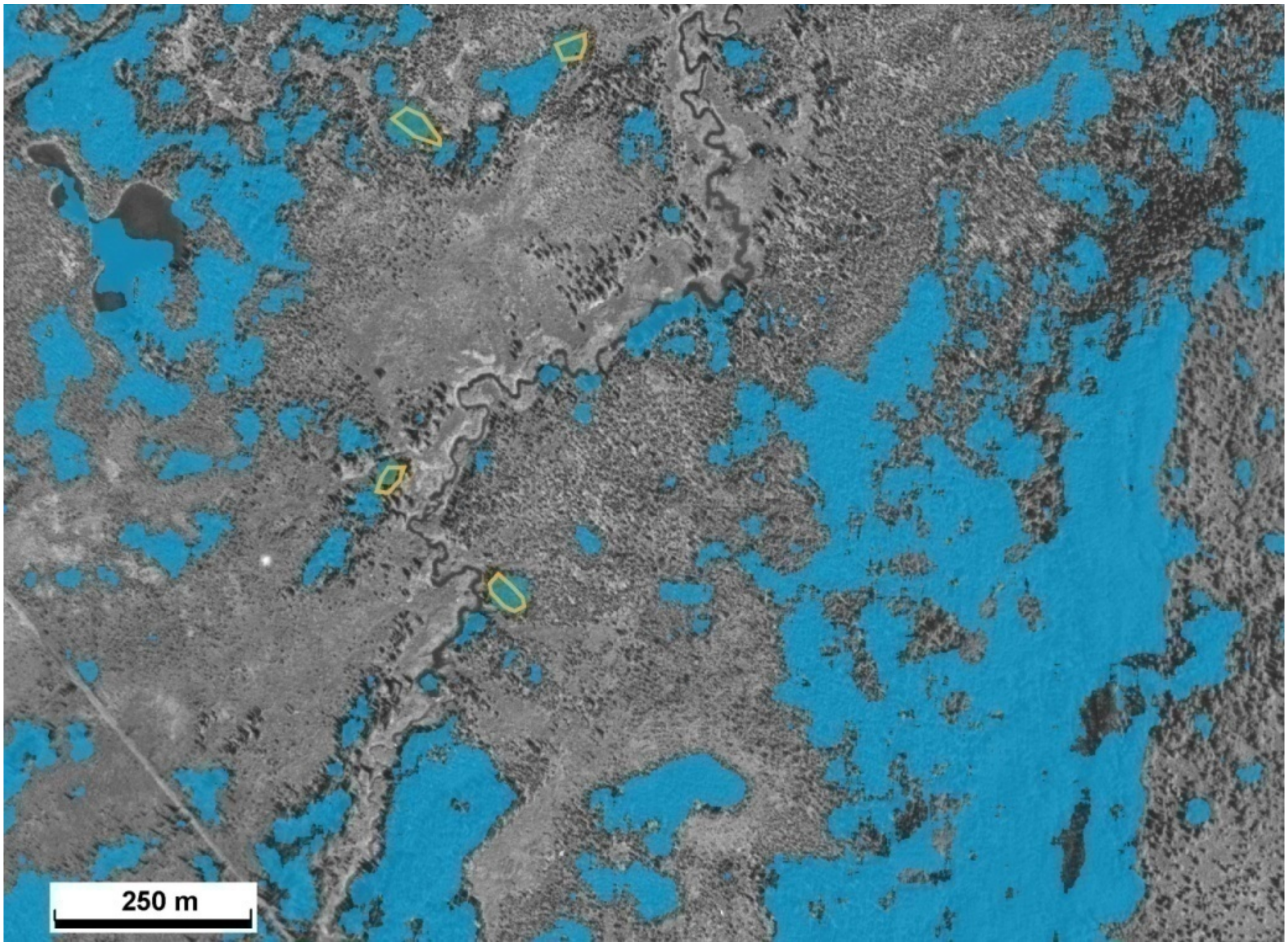


Figure 23. The image classification results. Blue is the area classified as high archaeological potential. Note that while our targeted areas (orange polygons) are captured, large areas of relatively undifferentiated terrain (to eastern side of image) are also captured.

Review of the image classification model and comparison with the ground-truthing results suggests that this method of modelling may be of limited usefulness, particularly with the black and white orthophotos. An on-screen visual assessment of ground-truthing points that were observed in the field to be high potential locations but that were not captured by the IC model was performed. This was in order to see if the waypointed features were visible in the orthophoto, to determine why the model was missing them. This check revealed that the features recorded in the field observations were often extremely difficult to visually see in the orthophotos, and in many cases the image classification also failed to identify them.

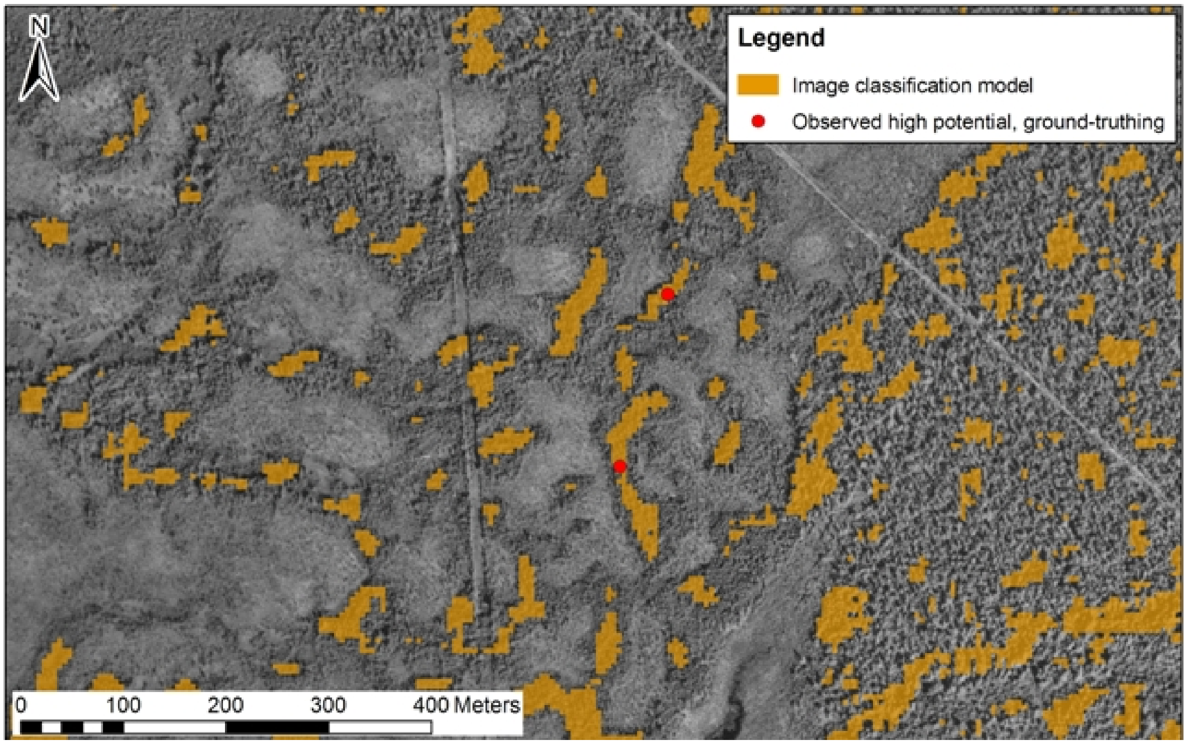


Figure 24. Red dots are high potential locations (observed while ground truthing), accurately portrayed by the image classification model.

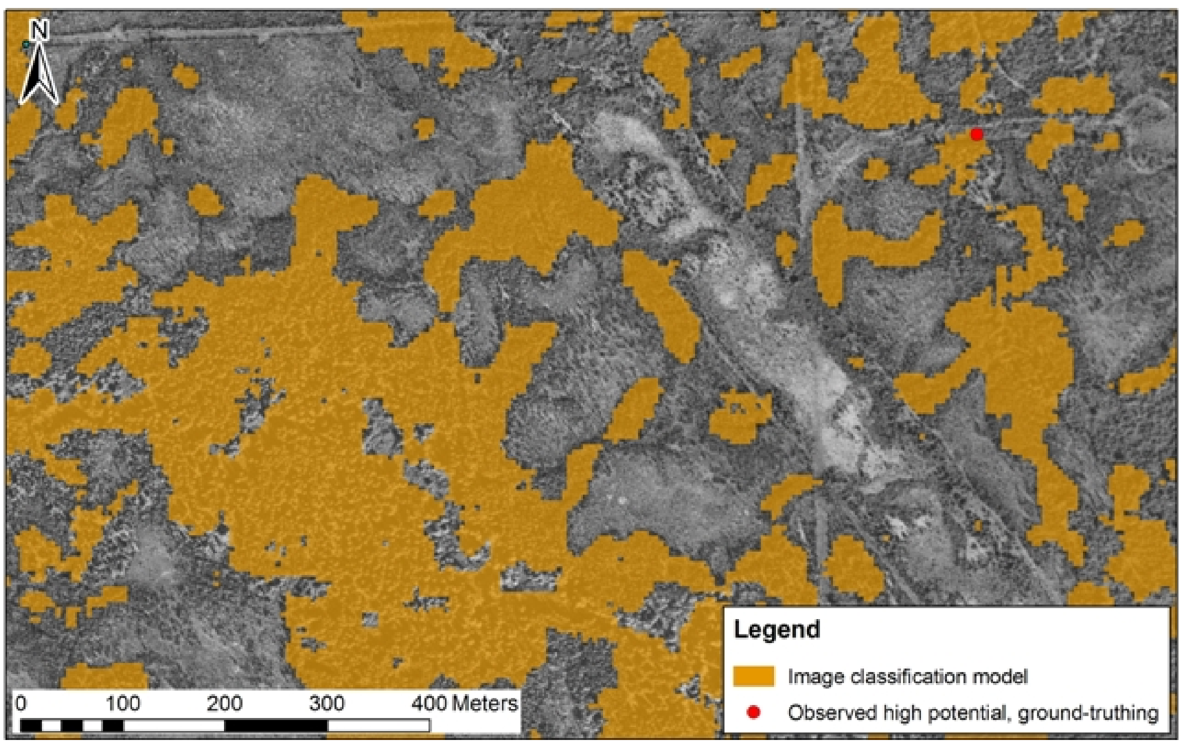


Figure 25. Red dot is an observed high potential location from ground truthing, that is being correctly captured by the model. To the west, the image classification model is capturing larger undifferentiated areas.

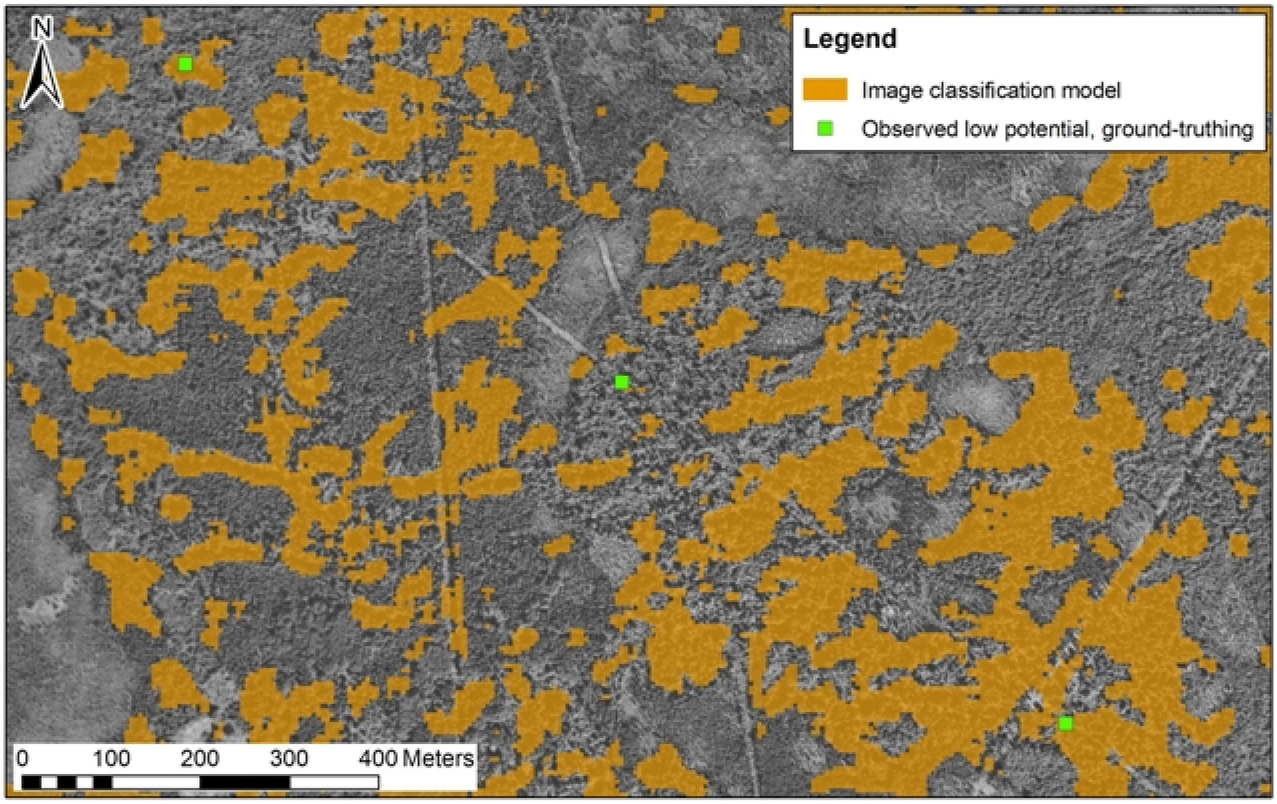


Figure 26. Green squares are ground truthing points that were observed as low potential, but where the image classification shows high potential.

Because the feature observed in the field to have high potential was frequently not apparent in the orthophoto, the waypoints could not be shifted onto the feature, so standard GPS error had to be accounted for when calculating the statistics to determine the model performance. Therefore, a 10 m buffer on the waypoint was intersected with the model to determine if the ground-truthing points were within 10m of being captured, in addition to intersecting the point itself with the model to calculate capture rate.

Of the ground-truthing points, only 14% of the observed high potential points were captured directly by the image classification high potential model. This number goes up to 33% capture when the 10 m buffers are applied. A total of 8.5% of the land area is captured by the image classification high potential. If the Kv gain is calculated using the buffered points (33%), it results in a Kv gain of 0.74.

Of the archaeological sites recorded in the area, only 32% were captured by the model (not using buffering). While this may increase with buffering to account for the possibility of sites being plotted incorrectly, it is unlikely to increase the capture rate to the required 70%, and so buffering was not performed.

Unfortunately, we must conclude that the image classification, while initially promising, is simply not performing well enough over large areas to justify its inclusion in the model. It is also very time-consuming and processing-intensive, making it much less efficient and effective than DEM-based modelling. While colour imagery may improve the results significantly, because it contains far more spectral information than black and white, this also increases the processing time dramatically.

8.0 RECOMMENDATIONS

The archaeological record is of importance to all British Columbians. Most of this record is of aboriginal peoples, and for the descendant communities this evidence of their ancestors' use of the land has especially strong significance. An obligation exists for development proponents to preserve this record and to take it into account in their planning because preservation of this important record is subject to legislative protection for much of the record and resulting regulations must be followed. In regards to responsibilities of licensees, developers, and regulators, use of the model is **NOT** a substitute for consultation with First Nations, whose aboriginal rights and concerns cover a much wider scope of topics than just the archaeological record, and who may have specific information about archaeological sites that are not in the provincial inventory and may be outside modeled high potential areas as presented in the model.

Current models for the Northeast emphasize landforms as the most important variable for predicting the location of archaeological sites. Our modeling approach and technique gives users the ability to identify with great precision almost all of the landforms predicted to high potential. What is missing in a large number of areas is the data needed for this approach. In particular we lack high-resolution DEM that we can use to obtain greater precision for our archaeological models. LiDAR provides the ideal data source for improved modeling in the NE with its 1-2 m spacing of elevation data points accurate to a few centimetres relative to their neighbours. This is not to say that the model based on TRIM is of no use; in fact, it fully meets provincial standards set by the Archaeology Branch for a large part of the area and is still useful in the remainder. However, qualifications and guidance for use of the TRIM based model follow.

Users of the model should first determine which region designation applies to their area of study. The TRIM model is divided into two regions, based on the degree to which the model meets government modeling standards. In Region 1, with its higher relief, the model meets standards both for capture of a suitably large percentage of the known sites, and for having an efficient Kvamme's Gain. In these areas, about 80% of the known sites are within the modeled area, and the model can be relied upon to provide strong support for decisions on whether further archaeological assessments are necessary. Even in these areas, however, the model should not be used in exclusion of other data, including for example traditional use information from First Nations, high-resolution orthophotos, surficial geology mapping, or prior expert knowledge of the specific locale. The model should also be used as a guide rather than a simple black-and-white decision-maker. For instance, if the model is showing long, but discontinuous, strips along a natural linear feature, such as a terrace edge, additional high potential may occur in the gaps. It may be that the terrace edge in actuality continues but a wobble in the linear feature results in the TRIM DEM having attributes that are just below model selection thresholds. A development that applies only to the 'gap' in the model should examine other data to ensure that the high potential landform is, in fact, absent.

In Region 2, low relief predominates and most sites are associated with microtopographic landforms too small for TRIM data to capture. The model meets Kvamme's Gain standards for efficiency – where it predicts sites, they are likely to be present – but it misses the majority of known sites that occur on microtopographic landforms that are essentially scattered randomly across the landscape. In Region 2, **the model should be used with caution,** as it can potentially miss areas with high potential. If the model suggests potential, then there is a strong likelihood of conflicts with archaeological resources. However, other information, such as those described in the preceding paragraph, should be used to make the decision regarding additional archaeological study in the areas where no potential is indicated.

For users without GIS systems, the models are available in two formats: as a RAAD overlay useable on-line, and as a Google™ Earth® "kmz" file. The latter will be available through data requests to the Archaeology Branch:

see http://www.tca.gov.bc.ca/archaeology/requesting_archaeological_site_information/index.htm.

RAAD has its own users guides and help menus:

see http://www.tca.gov.bc.ca/archaeology/archaeology_professionals/index.htm.

Google™ Earth is a free internet-based program that allows viewers to see detailed 3-D images of virtually any locality on earth. Essentially a GIS, one can turn layers of information on and off, measure distances or areas, and add notes and comments in several ways, one of which is through 'place marks' that can easily be shared through email. One of the lesser-known capabilities of Google™ Earth is the ability to add custom information layers. These layers are stored on the user's computer, and are not publically available to other users through Google™ Earth. These layers have a '.kmz' file name suffix. The model can be viewed in Google™ Earth as either a solid or transparent layer, or as an outline over the top of the Google™ Earth imagery that varies from 10m resolution satellite imagery to 1 m or better colour orthophotos for many areas. The terrain can be exaggerated to make slopes more readily visible and the map tilted and rotated for oblique viewing angles, something that is not readily done even by most GIS systems. Linework for proposed developments (pipeline routes, forest cutblocks etc) can also be shared through kmz files, allowing for easy review of the model. Users should be aware that the Google™ Earth DEM is less detailed than even the TRIM DEM, and so only large landscape features will be evident. Smaller features caught by the TRIM based potential model may not be evident, and in LiDAR areas very few locations will show in their true shape. Even with these issues, it remains an excellent and cost-free alternative to GIS systems.

The following discussion is mainly aimed at professional archaeologists interpreting the model maps and using them in the field. The model (outside LiDAR modeled areas) selects for medium and large landforms. The landforms have potential; however, the selection of specific locations for testing will require ground-observation to determine where, within the general area, shovel testing or intensive surface inspection is required. In some cases, such as slowly changing slope gradients from a plateau to a valley side, the model may select the area as high potential, but on the ground no specific locations to test may be found (such as would occur along a well defined slope break).

Areas, such as the margins of glacial lakes, are of particular interest due to the high scientific significance of paleoindian remains. In such areas, landforms with the highest potential for ancient sites may not be captured by the model; for instance in swale locations that afforded protection from sweeping winds (e.g., Dyke and Stewart 1985; Oetelaar 2004). Glacial lake strandlines may be visible in the model as long curvilinear lines of potential that cross-cut the glacial striation ridging, drumlins, or random hummocks of mass wasting that are the basis of much of the area topography. Where such lines are present, a strandline should be suspected. If multiple such lines occur and are parallel to each other, glacial lake strandlines may be strongly suspected.

TRIM model users should be aware the model occasionally selects areas of roads and DEM tiling errors (see discussion in Results) as high potential. These anomalies can usually be identified as a narrow strip of potential oriented north-south or east-west or following a main road. On the other hand, off-grid roads, especially older routes may follow ridge-lines that would have higher potential. Thicker potential polygons that follow the orientation of the local ridge topography (usually NE-SW) indicates genuine potential. Turning on the hillshade layer and zooming out may reveal tiling artifacts, and viewing the orthophoto layer will usually resolve any uncertainty.

Field archaeologists are encouraged to directly download the model and display it as a layer in their field GPS. This practice will provide an efficient means to determine the location of modeled high potential in the field. This method is virtually mandatory when using LiDAR models, as the small pixel size makes precise navigation otherwise difficult (using traditional methods of viewing field maps), unless the development area is very small and well marked and the model is displayed over the development plan. The Archaeology Branch will arrange to download the model in an appropriate format following a data request.

The greatest model improvement will be the addition of LiDAR DEMs that can be modeled using (at least as a starting point) the variables and formula used in the LiDAR test areas of the present project. As these are made available, they should replace sections of the TRIM based models. The LiDAR models are all expected to greatly exceed government standards and should be treated as 'Region 1' model. However, LiDAR-based models also have errors. Many developments such as major roads or borrow pits will produce characteristics that mimic high potential natural features and the model will select for them (for instance, flat-topped raised berms beside highway ditches that appear to the model to be low ridges). These anomalies are usually obvious to the viewer, especially if viewed in a GIS with orthophotos or in conjunction with OGC line-work for pipelines, roads etc. Model users should be aware that 'thickening' of the potential area along anthropogenic features usually indicates the presence of a natural formation that the modern development has truncated. These areas likely have archaeological potential. Presently, the LiDAR model selects some landforms that have relatively low potential; for instance, a hummock that is saturated due to perched water tables, or clay soil. However, the decision to 'downgrade' the feature to low potential usually requires a field visit. Small meandering creeks can also produce false high potential. A meander loop that isolates a small 'peninsula' of land connected by a narrow 'neck' to the surrounding area appears to the model to be a low hill rising above its surroundings, rather than flat land that has been isolated by erosion. These situations are rare, however, and with some practice can be 'read' from the model. Meandering larger creeks and rivers tend to produce features with genuine potential as the channels in the floodplain shift.

Recently archaeologists conducting AIAs are required by the Archaeology Branch to submit shapefiles of the study area in which they worked. Unfortunately, these large polygons are not required to show areas of relative potential. Standardized reporting forms (Appendix B) for non-permitted preliminary field reconnaissance observations, and other professional users of the model are asked to submit forms and maps with brief notations of potential as it appeared on the ground to assist in model evaluation and improvement. BC Timber Sales, Ministry of Forests and Range, Peace-Liard Timber Sales, Dawson Creek, B.C. has agreed to serve as a central repository for these forms.

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Appendix A

Final Model

Final Model

Variables used in final model:

- Slope (in degrees) – **Slope**
- Range of slope 9×9 – **SlopeRng9**
- Positive 25×1 (maximum of horizontal and vertical) – **Positive25**
- Negative 25×1 (minimum of horizontal and vertical) – **Negative25**
- Positive 9×9 – **Positive9**
- Positive count 9×9 – **Count**

The final model was built up from the following layers:

1) Positive25 > 500 **&** Slope ≤10
2) Positive25 > 250 **&** Slope ≤ 5
3) Positive9 > 300 **&** Positive25 > 300 **&** Count > 50 **&** Slope <= 5
4) Negative25 ≥ -1 **&** SlopeRng9 > 10 **&** Slope ≤ 15
5) Positive9 > 250 **&** Count > 40 **&** Slope < 10 **&** Negative25 > -215
6) Slope ≤ 10 **&** Count > 40 **&** Positive9 > 500 **&** Positive25 > 100

TUS Area layers (only applied within TUS areas):

7) Negative25 > - 350 **&** Positive9 > 350 **&** Count > 40 **&** Slope < 15
8) Positive9 > 400 **&** Count > 40 **&** Slope < 15
9) Positive9 > 100 **&** Count ≥ 60 **&** Slope < 5

Layers 1 to 4 are the original terrain model. Layers 5 and 6 are the revised terrain model. Layers 7 and 8 are used within the TUS areas to expand the overall model to capture areas with higher slopes. Layer 9, also applied only within the TUS areas, captures very small features. Layer 9 captures so much that single pixels were removed from the layer before combining it with the rest of the model layers.

Appendix B

Water Feature Model

Water Feature Model

The water features-based model, which was excluded from the final model, was created by first buffering water features using values statistically determined during the Northeast BC AOA (Eldridge and Anaya 2005). Water feature buffers were then converted to raster and combined as follows using map algebra (**bold** font indicates the buffer distance):

Very small lakes: **200m**
+
Small lakes: **250m**
+
Single line definite rivers: **200m**
+
Large wetlands: **100m** OR Small wetlands: **400m**

Reclassify result to > 1
OR
Large lakes: **1000m** AND Single line definite rivers: **250m**
OR
Medium lakes: **400m**
OR
Double-line rivers: **400m**

This resulted in a raster with two values: 0 and 1, which was then restricted to areas where the slope was ≤ 15 degrees, creating the water-feature based portion of the model.

Appendix C

Review of Preliminary Ground-truthing Results (Areas 1 and 2) and Discussion of Water Model

Review of Preliminary Ground-truthing Results (Areas 1 and 2) and Discussion of Water Model

Area 1

Overall in Area 1, there were 24 non-matching ground-truthing locations. Of these, two locations are non-matching only because of disturbance (wellpads) which create low potential. In this area, there are 31 matching locations. Of the matching locations, 21 are captured in the terrain model only, and one is captured in the terrain and water models. Two of the remainder (which are captured in the water model only) are very close (within a pixel or two) to terrain modelling. Overall, this suggests that the terrain model is performing quite well.

In the Mt. Clifford area, all but one of the locations were matching, with the exception being a wellpad which was modelled high, but assessed as low due to disturbance. In this type of terrain, therefore, it appears the model is performing very well. However, in the lower-lying river valleys, the model is not performing as well. If the 11 matching Mt. Clifford locations are excluded from the overall numbers, there remain 20 matching locations and 23 (excluding the one Hambler non-matching location) non-matching locations. Of these lower-elevation river valley locations, only 11 are terrain-captured matching locations. This suggests that if the water model is removed from the overall model, performance will suffer. Of the nine water-captured matching locations in the river valley area, five have comments suggesting they are located on terrain features which are simply not large enough to be captured by TRIM. Three of the remaining four locations are noted as being on fairly level terrain overlooking a lake, which, based on that description, are unlikely to be captured in a terrain model. This suggested that the water model could be greatly decreased, if not discarded, limiting it to suitable slopes within an appropriate distance of lakes (perhaps only larger lakes). This would exclude wetlands and rivers, along which it seems the potential is related more to the landform than to the proximity to the water feature, and would result in greatly reduced overall land capture. A single location on the “bank of Kinuseo Creek” doesn’t have any notations as to any other landform features (e.g. terrace, ridge, etc.), but it is possible that a higher quality DEM (such as LiDAR) would be able to capture the high potential areas along the banks of the river such that this location would be captured. In the Mt. Clifford area, there is only one location that is captured by the water model. This location is not captured in the terrain model, and is noted to be on “elevated terrain adjacent to wetland”.

Area 2

There were a total of 57 non-matching locations in Area 2, and 27 matching locations. A portion of this area was modelled using image classification, which was analyzed separately. The majority of the non-matching locations were features too small to be modelled using the TRIM DEM – in most cases, they were not even faintly visible on the hillshaded DEM. Many of the terrain descriptions run something like this: “knoll, 2 m high, 5 by 10 m”, “ridge, poorly-defined”, and so on. These are features which would not be modelled in the TRIM DEM due to its scale (actual elevation points ~80 m apart, interpolated to 25 m cells). However, LiDAR, with often a horizontal resolution of 1-2 m, and a vertical resolution in centimetres, would show these small, but high potential, landforms. Many of the matching locations are matching only due to the water model – but the descriptions for these are similar to many of the non-matching locations, referencing small knolls, ridges, and terraces. In this area, none of the high-high matching locations appear to be high potential solely due to their proximity to the water feature. Rather, it is the landform which is referred to in the ground-truthing description; these may be higher potential due to their proximity to water, but there are also areas close to the water which are considered low potential. A good example of this can be seen in the following figures (Figure C-1, Figure C-2).

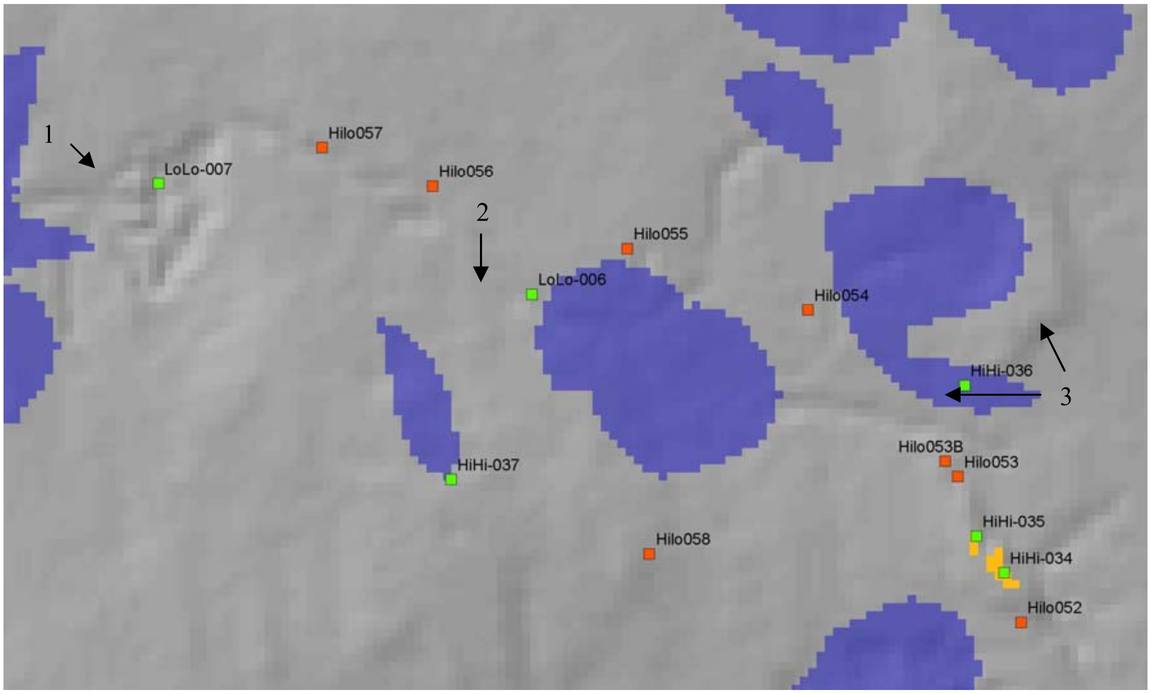

Figure C-1. A portion of Area 2 matching (green) and non-matching (red) locations with water (blue) and terrain (orange) models displayed over hillshaded TRIM DEM.

Figure C-1 and Figure C-2 show a portion of the surveyed Area 2, with the recorded matching and non-matching locations (green and red points, respectively). The models, water in blue and a tiny area of terrain in orange, are also overlaid, with the DEM hillshade as the base. Figure C-2 adds the TRIM water features to this map. This area contains a few items of note:

1. Matching location "LoLo-007" which is described as being "flat, featureless, [and] poorly-drained" appears in the hillshaded DEM to in fact have some terrain variation. Figure C-2 shows that this is in fact a wetland; the apparent terrain variation is likely due to DEM creation errors (breaklines with different elevations than surrounding terrain, as discussed in the main body of the report). Because of this, this low potential area may be incorrectly assigned to high if the model were adjusted to capture smaller features.
2. Matching location "LoLo-006" is located in close proximity to a TRIM single-line definite river, which suggests that proximity to the water feature is not the source of potential, but rather, as in the case of non-matching locations "HiLo-056" and "HiLo-057", due to terrain features such as small knolls.

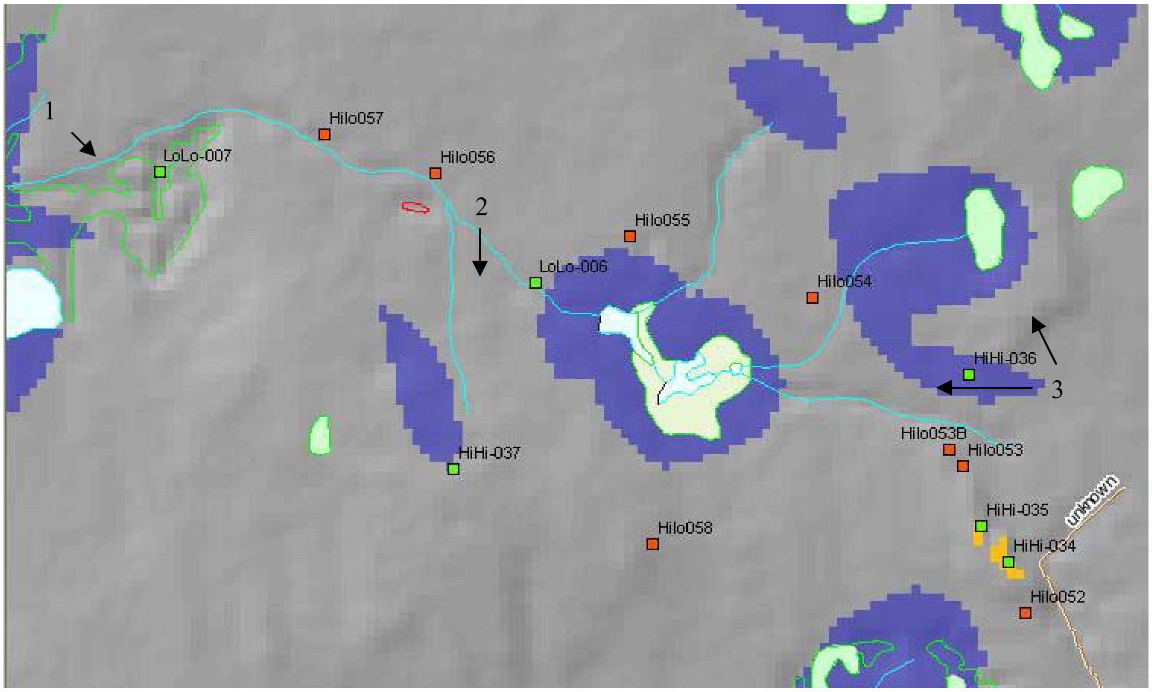

Figure C-2. Same location as Figure C-1, showing TRIM water mapping.

Summary of Water Feature Model

Overall, the water portion of the model, while it does capture sites and areas of potential is not a good indicator of potential. The ground-truthed high potential locations have more to do with terrain features (e.g. knolls, ridges, terraces) and less to do with proximity to a water body. The water model may indicate higher potential for terrain features (i.e. a knoll close to a river, or a terrace overlooking a river would be higher potential than a knoll/terrace further away from a river), but does not seem to be in itself an indicator of potential. There are areas within the water buffer model that are considered low potential, due to their lack of identifiable terrain features. Another factor to consider is that on occasion these high potential landforms were noted in the field to occur next to "significant drainages" – these drainages were classed in the mapping data as TRIM single line definite rivers. If these are indeed significant features on the ground, they should be buffered – the difficulty is that there are far too many "single line definite streams" to buffer them all. The ground area captured in the model if these streams were buffered as part of the model would be so high as to make the model useless. Further, there are noted areas of low potential located directly beside a "single line definite stream".

Appendix D

Proposed and Tested Model Refinements

Appendix D: Proposed and Tested Model Refinements

A variety of model refinements were proposed and tested. Those that were included in the final model are listed in Appendix A. Those discussed below were not used, for reasons which are included in the discussions below.

Confluences:

Comments received from the field crew suggested that there was significant observed high potential that was not being captured by the terrain model, located at the confluences of rivers. This was the case where the confluence of two (or more) rivers has created a raised landform, and the field crew suggested these confluences should be buffered for addition to the model. Based on this knowledge, an attempt was made to model high potential at river confluences for addition to the overall model.

A small area where ground-truthing had taken place (and where field notes contained comments about the high potential of river confluences) was used to test if modelling of confluences would be effective. The base data used was the TRIM single-line definite rivers (there were no double-line rivers in this portion of the study area, which simplified matters). Using an ArcMap extension called "Hawth's Tools" the intersections of this TRIM lines layer were converted to points. Again using Hawth's Tools, the lines intersecting these new points were then enumerated – where there were at least 3 lines intersecting a point, that point must be a confluence (because a continuous section of a TRIM river is built up by line segments, where there are two lines intersecting a point, this is simply a spot along the river – at least 3 intersections are required for a confluence). The points which were determined to be confluences were then buffered to 100 m in radius. These buffers were then compared with ground-truthing points, to determine how many points were captured, in order to determine if modelling for river confluences would improve the capture of high potential locations and improve the overall model.

However, a 100 m buffer on these confluences only captured 4 of about 50 observed "high" ground potential points in the area. Expanding the buffers to 200 m captured more of the observed high potential locations, but also captured eight locations that were ground-truthed as low potential (likely due to slope, which could be used limit the confluences model). Of the 14 high potential captured locations, 6 were already captured by the revised terrain model. Seven of the points were in within ~ 50 m of each other, and therefore represented only one confluence. Five of these were close enough to the revised terrain model to be considered captured by that model. In summary, this means that the buffer of river confluences is unlikely to significantly improve the model performance (at best, only 16% more observed high potential locations would be captured by the model with the addition of buffering confluences), while at the same time, there are several difficulties with it. A primary limitation to modelling confluences is the available base data. TRIM data does not identify stream size or significance, other than at a fairly coarse scale. While the largest definite rivers are classified as "double-line" rivers, with polylines for the right and left banks, the remaining definite rivers are lumped into a "single-line" classification. Therefore, using this layer to model confluences does not distinguish in any way the size or significance of the river or the landform created by the confluence, so that all confluences are treated as equal. The TRIM DEM lacks the detail necessary to distinguish the significance of the confluences based on characteristics of terrain – were the detail available, it is almost certain that the significant confluences would be captured within the terrain model, without requiring identification and buffering of confluences. Also, the data set of rivers for the entire study area is very large, and would likely need to be separated into smaller chunks for processing, requiring several iterations of the processing, which is time consuming. The test results don't indicate that the layer would improve the model enough to justify this time expense.

Lake buffers:

While the water features model was scrapped early on in the process, due to initial ground-truthing results, these initial ground-truthing results suggested that the area around lakes may have higher potential. When the relationship of sites to larger lakes was assessed visually in the GIS, it certainly appeared to have a correlation. What is unknown is whether this apparent correlation is in fact due to the proximity to the lake, or whether other factors influence the location of these sites. The apparent higher density of sites close to the lakes may be due to survey bias; archaeological survey may have been concentrated along the lake shores due to development. Also, the comments received from the field crews suggest that, similar to confluences, it is primarily terrain which implies potential. A lake in a very low-lying area will not be considered the same potential as a lake that is surrounded by well-defined terraces or other landforms. This brings the model back to the terrain.

While the terrain may have higher potential near a lake than further away, lakes, without any other factors considered, cannot be considered as automatically having potential. This is particularly the case in the Peace FD, where many lakes are surrounded by wetland or have very little terrain variation. The places where the terrain is significant should be captured by the terrain model. Where the terrain is less prominent and cannot be captured using TRIM, a LiDAR-based model would almost certainly capture the high potential features beside lakes.

Appendix E

Image Classification Test

Image Classification Test

Mapsheet 94H, one of the northern, poorly performing model areas, was used to test the image classification. Colour 2005 orthophotos were available for a portion of the mapsheet, and one of these was selected to perform image classification. The original combined terrain and water models have created large areas of potential in this and other northern areas. Most of this is due to the water model (buffering on water features). While the water model may be significantly lessened in the mountainous areas by limiting it to lower slopes, in the flatter areas, it is not limited. This, combined with the higher numbers of water features (wetlands in particular, and the streams that connect them) creates a model that captures a large portion of the landscape.

Using the original combined terrain and water models, 26% of the land area in 94H is captured as high potential (Figure E-1), though less than half of the sites are captured. However, the preliminary image classification shows promise that the model may be refined to reduce land area and increase the number of captured sites.

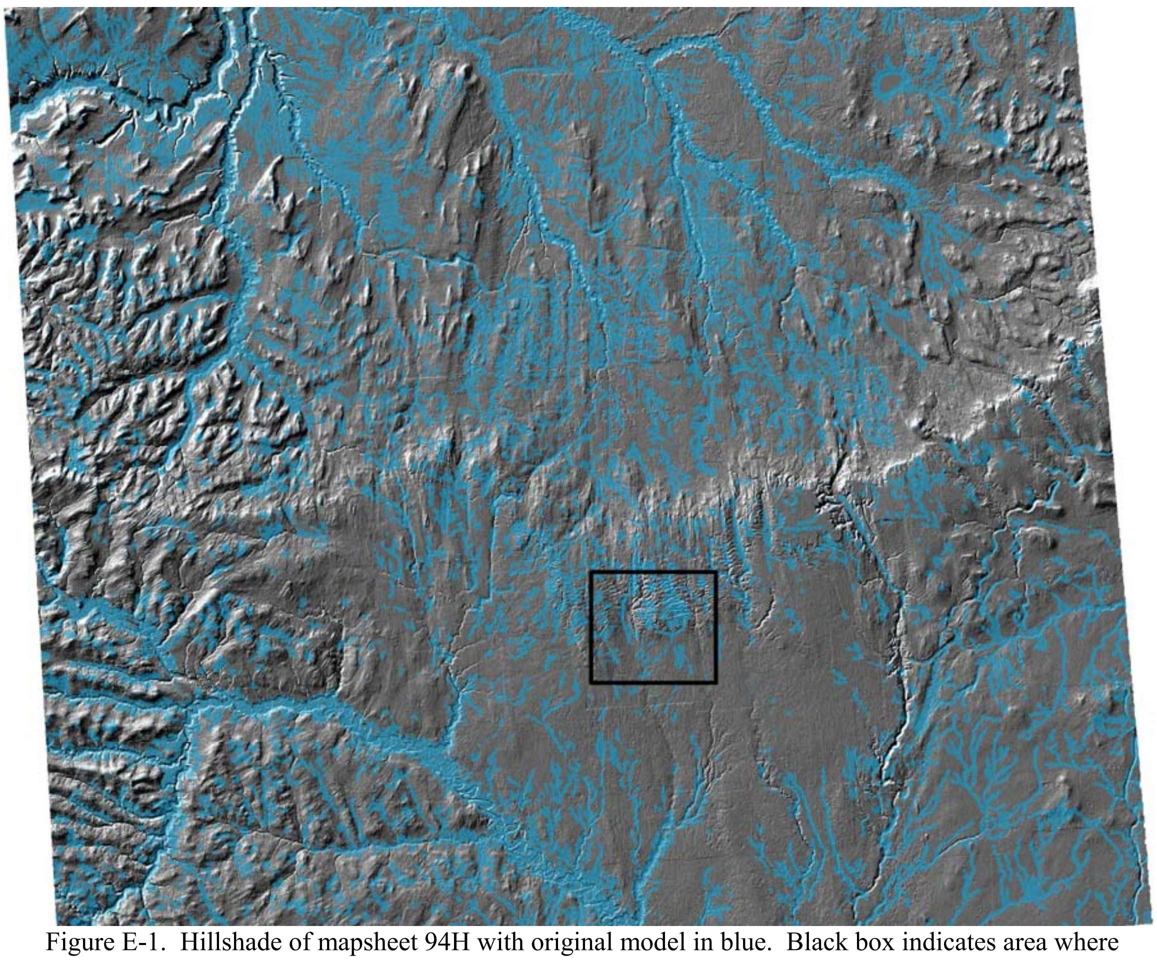

Figure E-1. Hillshade of mapsheet 94H with original model in blue. Black box indicates area where image classification was performed.

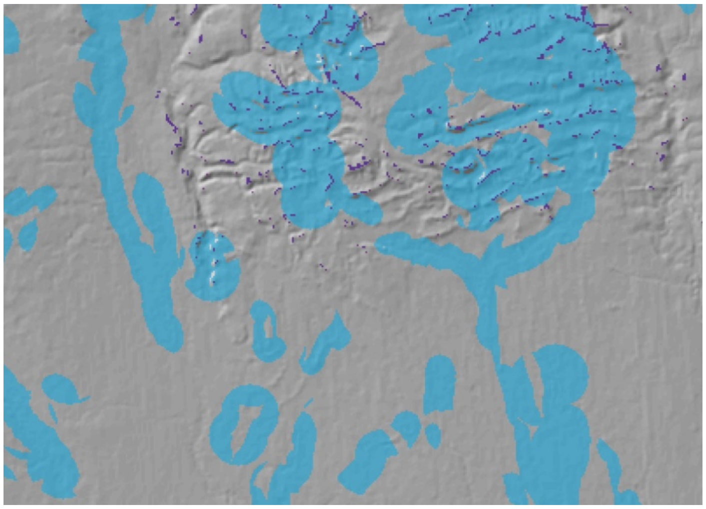

Figure E-2. Area of image classification showing the original model in blue and the terrain model in purple.

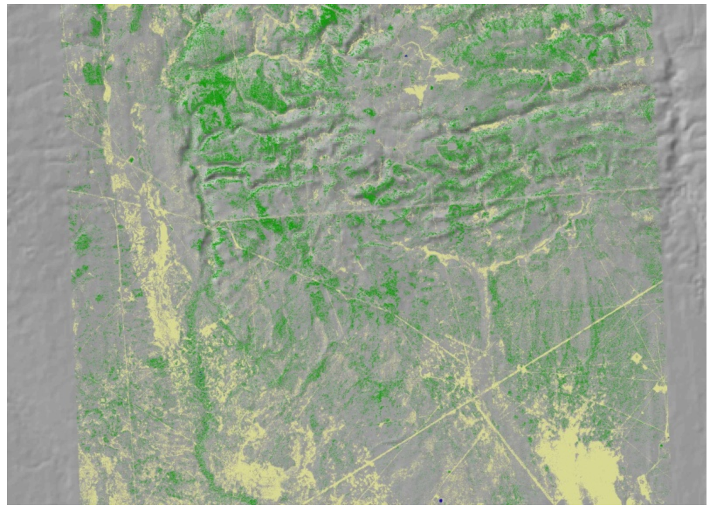

Figure E-3. Same area, showing the image classification. Green indicates high potential areas, light yellow are low potential (e.g. muskeg)

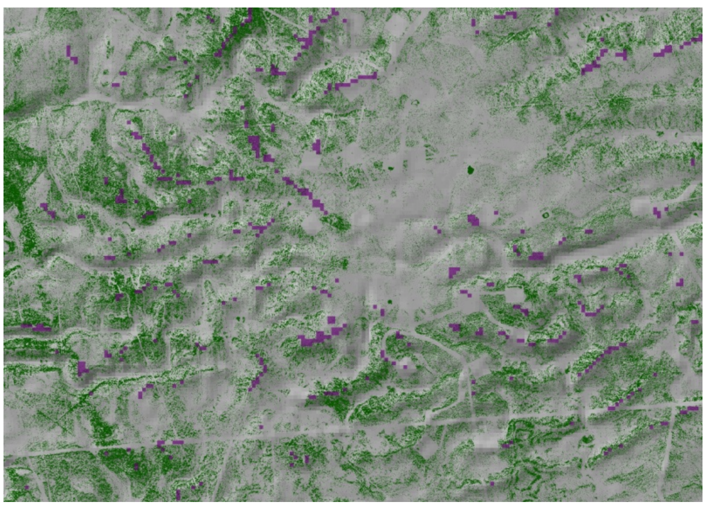

Figure E-4. A zoomed in look at the more hilly terrain, with the hillshade, image classification, and original terrain model. The terrain model (purple) matches quite well the image classification (green).

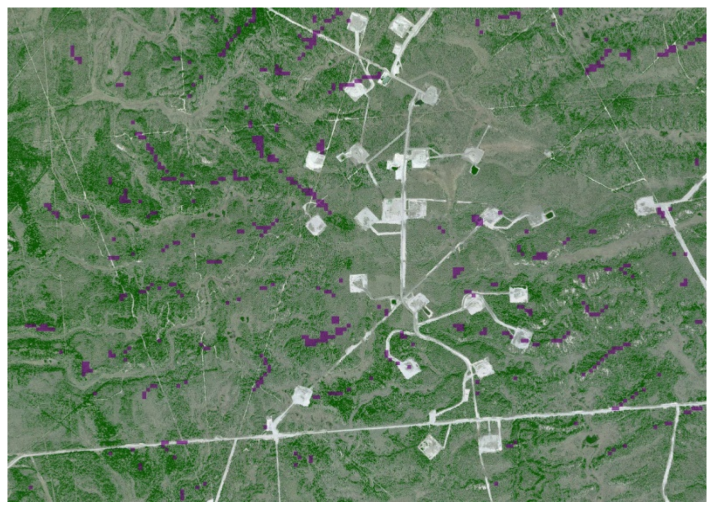

Figure E-5. Same view, with the orthophoto underneath.

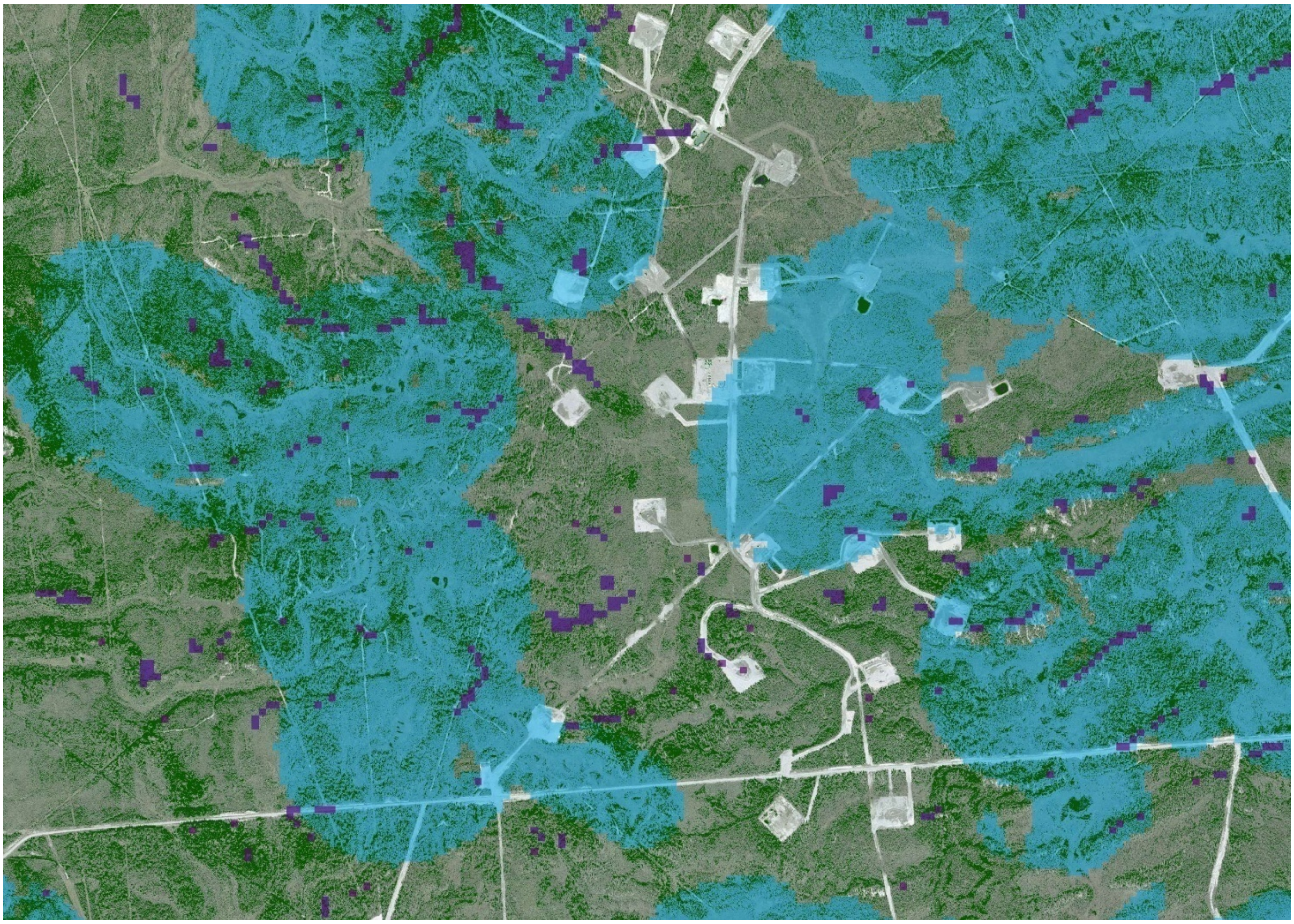

Figure E-6. Orthophoto with image classification (green), original terrain model (purple) and combined terrain and water models (blue). Note the large areas in the combined model where the image classification and the terrain model show much more specific features.

Figure E-7. Flatter area with image classification model. Green indicates areas to be modelled, yellow areas to be removed from model.

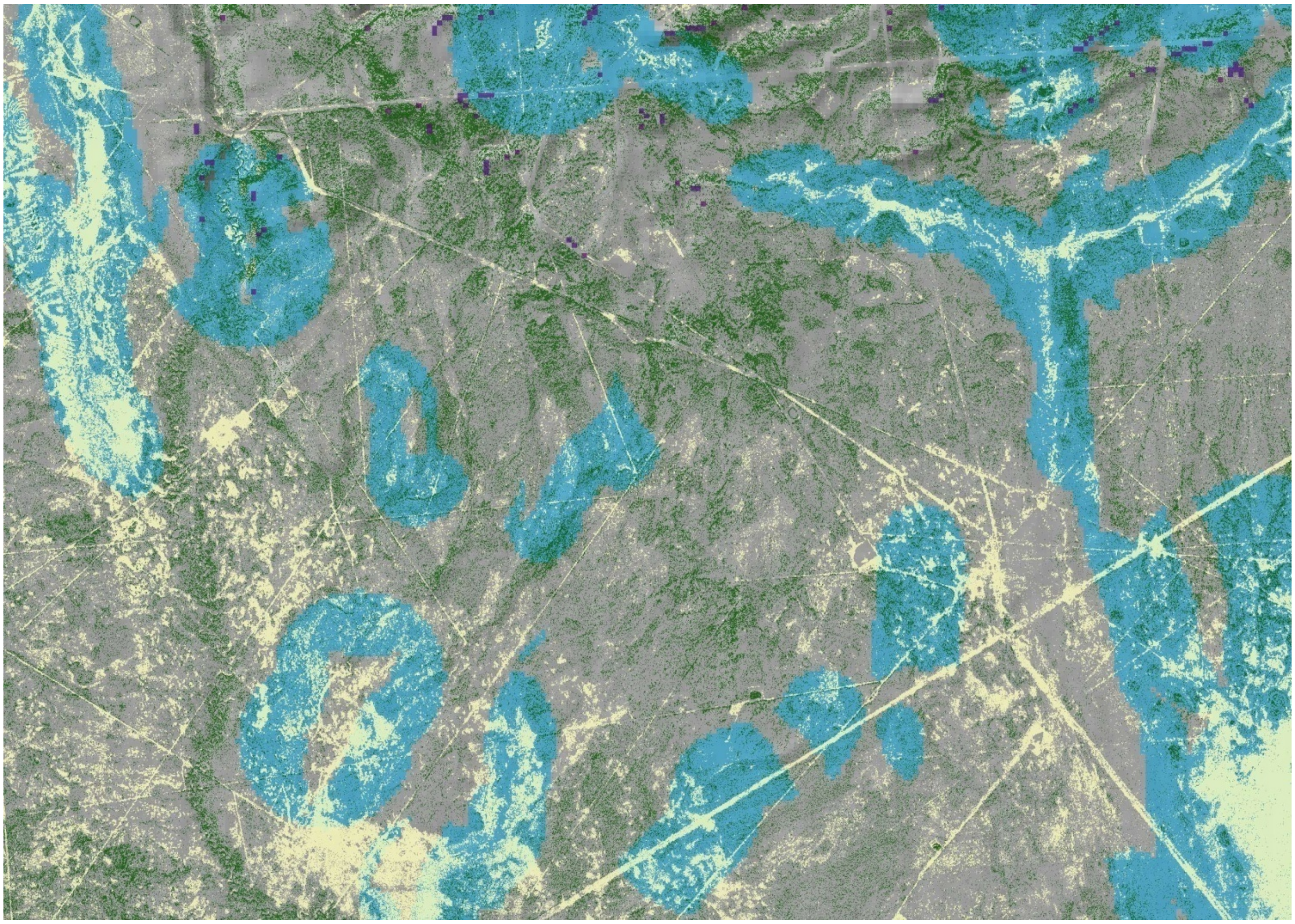

Figure E-8. Same view as Figure 15, with hillshade, terrain model (purple), and combined models (blue). Several areas in the final model are actually coded yellow in the image classification, therefore are low potential areas that should be excluded from the model. There is very little captured in the terrain model here, so the image classification could be useful in this type of landscape.

Appendix F

Detailed Ground-truthing Results Tables

Detailed Ground-truthing Results Tables

Ground-truthing Results by Area

Area 1

Ground-truthed Potential	TRIM Model Potential	# waypoint	Total # waypoints	% total
High	High	22	55	40.0
Low	High	1	55	1.8
High	Low	26	55	47.3
Low	Low	6	55	10.9

% Matching (High-High, Low-Low)	50.9
% Non-matching (High-Low, Low-High)	49.1

Area 2

Ground-truthed Potential	TRIM Model Potential	# waypoint	Total # waypoints	% total
High	High	19	65	29.2
Low	High	0	65	0.0
High	Low	35	65	53.8
Low	Low	11	65	16.9

% Matching (High-High, Low-Low)	46.2
% Non-matching (High-Low, Low-High)	53.8

Area 3

Ground-truthed Potential	TRIM Model Potential	# waypoint	Total # waypoints	% total
High	High	13	242	5.4
Low	High	2	242	0.8
High	Low	79	242	32.6
Low	Low	148	242	61.2

% Matching (High-High, Low-Low)	66.5
% Non-matching (High-Low, Low-High)	33.5

Area 4

Ground-truthed Potential	TRIM Model Potential	# waypoint	Total # waypoints	% total
High	High	60	572	10.5
Low	High	24	572	4.2
High	Low	262	572	45.8
Low	Low	226	572	39.5

% Matching (High-High, Low-Low)	50.0
% Non-matching (High-Low, Low-High)	50.0

Area 5

Ground-truthed Potential	TRIM Model Potential	# waypoint	Total # waypoints	% total
High	High	118	426	27.7
Low	High	35	426	8.2
High	Low	70	426	16.4
Low	Low	203	426	47.7

% Matching (High-High, Low-Low) 75.4
% Non-matching (High-Low, Low-High) 24.6

Area 6

Ground-truthed Potential	TRIM Model Potential	# waypoint	Total # waypoints	% total
High	High	45	616	7.3
Low	High	55	616	8.9
High	Low	85	616	13.8
Low	Low	431	616	70.0

% Matching (High-High, Low-Low) 77.3
% Non-matching (High-Low, Low-High) 22.7

Area 7

Ground-truthed Potential	TRIM Model Potential	# waypoint	Total # waypoints	% total
High	High	37	323	11.5
Low	High	41	323	12.7
High	Low	43	323	13.3
Low	Low	202	323	62.5

% Matching (High-High, Low-Low) 74.0
% Non-matching (High-Low, Low-High) 26.0

Area 8

Ground-truthed Potential	TRIM Model Potential	# waypoint	Total # waypoints	% total
High	High	65	392	16.6
Low	High	37	392	9.4
High	Low	81	392	20.7
Low	Low	209	392	53.3

% Matching (High-High, Low-Low) 69.9
% Non-matching (High-Low, Low-High) 30.1

All Areas				
Ground-truthed Potential	TRIM Model Potential	# waypoint	Total # waypoints	% total
High	High	379	2691	14.1
Low	High	195	2691	7.2
High	Low	681	2691	25.3
Low	Low	1436	2691	53.4

% Matching (High-High, Low-Low)	67.4
% Non-matching (High-Low, Low-High)	32.6

High potential ground-truthing points, Region 2 and Region 1

Area 1	Ground-truthed Potential	TRIM Model Potential	# waypoint	Total # waypoints	% total
Region 1	High	High	10	14	71.4
Region 1	High	Low	4	14	28.6
25m buffer Region 1	High	High	13	14	92.9
25m buffer Region 1	High	Low	1	14	7.1
Region 2	High	High	12	34	35.3
Region 2	High	Low	22	34	64.7
25m buffer Region 2	High	High	25	34	73.5
25m buffer Region 2	High	Low	9	34	26.5

Area 2	Ground-truthed Potential	TRIM Model Potential	# waypoint	Total # waypoints	% total
Region 2	High	High	19	54	35.2
Region 2	High	Low	35	54	64.8
25m buffer Region 2	High	High	30	37	81.1
25m buffer Region 2	High	Low	7	37	18.9

Area 3	Ground-truthed Potential	TRIM Model Potential	# waypoint	Total # waypoints	% total
Region 2	High	High	13	92	14.1
Region 2	High	Low	79	92	85.9
25m buffer Region 2	High	High	18	92	19.6
25m buffer Region 2	High	Low	74	92	80.4

Area 4	Ground-truthed Potential	TRIM Model Potential	# waypoint	Total # waypoints	% total

Region 2	High	High	45	300	15.0
Region 2	High	Low	255	300	85.0
25m buffer Region 2	High	High	83	300	27.7
25m buffer Region 2	High	Low	217	300	72.3
Region 1	High	High	15	22	68.2
Region 1	High	Low	7	22	31.8
25m buffer Region 1	High	High	18	22	81.8
25m buffer Region 1	High	Low	4	22	18.2

Area 5	Ground-truthed Potential	TRIM Model Potential	# waypoint	Total # waypoints	% total
Region 1	High	High	50	66	75.8
Region 1	High	Low	16	66	24.2
25m buffer Region 1	High	High	55	66	83.3
25m buffer Region 1	High	Low	11	66	16.7
Region 2	High	High	68	122	55.7
Region 2	High	Low	54	122	44.3
25m buffer Region 2	High	High	82	122	67.2
25m buffer Region 2	High	Low	40	122	32.8

Area 6	Ground-truthed Potential	TRIM Model Potential	# waypoint	Total # waypoints	% total
Region 1	High	High	1	1	100.0
Region 1	High	Low	0	1	0.0
25m buffer Region 1	High	High	1	1	100.0
25m buffer Region 1	High	Low	0	1	0.0
Region 2	High	High	37	122	30.3
Region 2	High	Low	85	122	69.7
25m buffer Region 2	High	High	45	122	36.9
25m buffer Region 2	High	Low	77	122	63.1

Area 7	Ground-truthed Potential	TRIM Model Potential	# waypoint	Total # waypoints	% total
Region 2	High	High	37	80	46.3
Region 2	High	Low	43	80	53.8
25m buffer Region 2	High	High	50	80	62.5
25m buffer Region 2	High	Low	30	80	37.5

Area 8	Ground-truthed Potential	TRIM Model Potential	# waypoint	Total # waypoints	% total
Region 1	High	High	49	108	45.4
Region 1	High	Low	59	108	54.6
25m buffer Region 1	High	High	57	108	52.8
25m buffer Region 1	High	Low	51	108	47.2
Region 2	High	High	16	38	42.1
Region 2	High	Low	22	38	57.9
25m buffer Region 2	High	High	19	38	50.0
25m buffer Region 2	High	Low	19	38	50.0

All Areas	Ground-truthed Potential	TRIM Model Potential	# waypoint	Total # waypoints	% total
Region 1	High	High	125	211	59.2
Region 1	High	Low	86	211	40.8
25m buffer Region 1	High	High	144	211	68.2
25m buffer Region 1	High	Low	67	211	31.8
Region 2	High	High	247	842	29.3
Region 2	High	Low	595	842	70.7
25m buffer Region 2	High	High	352	842	41.8
25m buffer Region 2	High	Low	490	842	58.2

Ground-truthing points comparison to Northeast BC AOA model

Area 2

Ground-truthed Potential	TRIM Model Potential	# waypoint	Total # waypoints	% total
High	High	31	65	47.7
Low	High	2	65	3.1
High	Low	23	65	35.4
Low	Low	9	65	13.8

% Matching (High-High, Low-Low)	61.5
% Non-matching (High-Low, Low-High)	38.5

Area 3

Ground-truthed Potential	TRIM Model Potential	# waypoint	Total # waypoints	% total
High	High	24	242	9.9
Low	High	13	242	5.4
High	Low	68	242	28.1
Low	Low	137	242	56.6

% Matching (High-High, Low-Low)	66.5
% Non-matching (High-Low, Low-High)	33.5

Area 5
(% area covered by model = 55.40%)

Ground-truthed Potential	TRIM Model Potential	# waypoint	Total # waypoints	% total
High	High	63	236	26.7
Low	High	20	236	8.5
High	Low	46	236	19.5
Low	Low	107	236	45.3

% Matching (High-High, Low-Low)	72.0
% Non-matching (High-Low, Low-High)	28.0

Area 7

Ground-truthed Potential	TRIM Model Potential	# waypoint	Total # waypoints	% total
High	High	36	323	11.1
Low	High	63	323	19.5
High	Low	44	323	13.6
Low	Low	180	323	55.7

% Matching (High-High, Low-Low)	66.9
% Non-matching (High-Low, Low-High)	33.1

All areas

Ground-truthed Potential	TRIM Model Potential	# waypoint	Total # waypoints	% total
High	High	154	866	17.8
Low	High	98	866	11.3
High	Low	181	866	20.9
Low	Low	433	866	50.0

% Matching (High-High, Low-Low)	67.8
% Non-matching (High-Low, Low-High)	32.2

High potential ground-truthing points, Region 2 and Region 1

Area 2	Ground-truthed Potential	TRIM Model Potential	# waypoint	Total # waypoints	% total
Region 2	High	High	31	54	57.4
Region 2	High	Low	23	54	42.6
25m buffer Region 2	High	High	40	54	74.1
25m buffer Region 2	High	Low	14	54	25.9

Area 3	Ground-truthed Potential	TRIM Model Potential	# waypoint	Total # waypoints	% total
Region 2	High	High	24	92	26.1
Region 2	High	Low	68	92	73.9
25m buffer Region 2	High	High	43	92	46.7
25m buffer Region 2	High	Low	49	92	53.3

Area 5	Ground-truthed Potential	TRIM Model Potential	# waypoint	Total # waypoints	% total
Region 1	High	High	35	57	61.4
Region 1	High	Low	22	57	38.6
25m buffer Region 1	High	High	45	57	78.9
25m buffer Region 1	High	Low	12	57	21.1
Region 2	High	High	28	52	53.8
Region 2	High	Low	24	52	46.2
25m buffer Region 2	High	High	41	52	78.8
25m buffer Region 2	High	Low	11	52	21.2

Area 7	Ground-truthed Potential	TRIM Model Potential	# waypoint	Total # waypoints	% total
Region 2	High	High	36	80	45.0
Region 2	High	Low	44	80	55.0
25m buffer Region 2	High	High	57	80	71.3
25m buffer Region 2	High	Low	23	80	28.8

All areas	Ground-truthed Potential	TRIM Model Potential	# waypoint	Total # waypoints	% total
Region 1	High	High	35	57	61.4
Region 1	High	Low	22	57	38.6
25m buffer Region 1	High	High	45	57	78.9
25m buffer Region 1	High	Low	12	57	21.1
Region 2	High	High	88	224	39.3
Region 2	High	Low	136	224	60.7
25m buffer Region 2	High	High	141	224	62.9
25m buffer Region 2	High	Low	83	224	37.1

Appendix G

Peace AOA – First Phase of Ground-Truthing Potential Model
Heritage Inspection Permit #2008-0333
Ewan Anderson - Author

1.0 INTRODUCTION

This report summarizes the results of fieldwork conducted to test a preliminary archaeological potential model developed for the Peace Forest District. The Peace Archaeological Overview Assessment (AOA) project is undertaken by Arcas Consulting Archeologists Ltd. (Arcas) in partnership with Millennia Research Limited (Millennia) and Timberline Natural Resources Group (Timberline) on behalf of B.C. Timber Sales (BCTS). The project involves the development of a modeling tool that will replace previous potential models developed for the region.

Fieldwork is conducted to test the preliminary archaeological potential model for the Peace Forest District, generating fine-grained site-location information and non-site or negative data. The various potential ratings generated by the preliminary GIS-based model are tested in the field. The results of research of traditional use site information are also to be tested and participants from all Aboriginal groups with territory in the study area are invited to assist with field work.

2.0 METHODS

2.1 Permit Application

In April 2008, Ewan Anderson (Arcas) applied for a *Section 14* Archaeological Inspection Permit to conduct fieldwork in the Peace Forest District for the purposes of testing the preliminary Peace AOA model. This permit is required to conduct significant testing within the boundaries of known or un-documented archaeological sites, as a possible consequence of ground-truthing the preliminary model. Permit 2008-0333 was issued by the Archaeology Branch, Ministry of Tourism, Culture and the Arts on August 14th, 2008.

2.2 Location Selection

Study locations were chosen based on a variety of factors, including:

- ease of access (using existing highways, 4x4 roads and ATV trails)
- variation of site types (lithic scatters, culturally modified trees, burials, habitation sites and trails)
- variation of environmental zones (*e.g.*, biogeoclimatic zones (Boreal White and Black Spruce, Engelmann Spruce Subalpine Fir, Sub-Boreal Spruce and Spruce-Willow-Birch] and ecosections)
- number or density of known site locations
- locations that have had little or no archaeological research
- archaeological potential ratings (based on the preliminary GIS-based model)
- modeling method (terrain model *v.* image classification

As a result, two general locations were chosen for the first round of fieldwork. Area 1 is located south of the town of Tumbler Ridge and covers lands adjacent to Kinuseo Creek, east of the Murray River and west of Stony Lake. The northern boundary of Area 1 follows a line of hills, including

Quintette Mountain (1826 m asl) – another set of hills, including Mount Clifford (1736 m), forms the southern boundary (Figure G-1). The area is characterised by a long broad valley (Kinuseo Creek) in the Rocky Mountain Foothills. Low peaks (between 1600 m and 1850 m above sea level) are located to the north and south. Kinuseo Creek is fed from the north and south by several smaller creeks (Quintette Creek, Flatbed Creek, Onion Creek and Hambler Creek). This section of study area also contains numerous historic and prehistoric resources. A total of 28 previously documented archaeological sites are located within Area 1. These include lithic scatters, historic cabins and trails. Sections of the historic Monkman Pass Highway, constructed in the 1930's, provide easy access to the study area. Area 1 was also selected due to the presence of numerous traditional trails, as indicated by previous traditional use studies including amongst others the Monkman Pass and Trail History Project (e.g. Petro-Canada 1982).

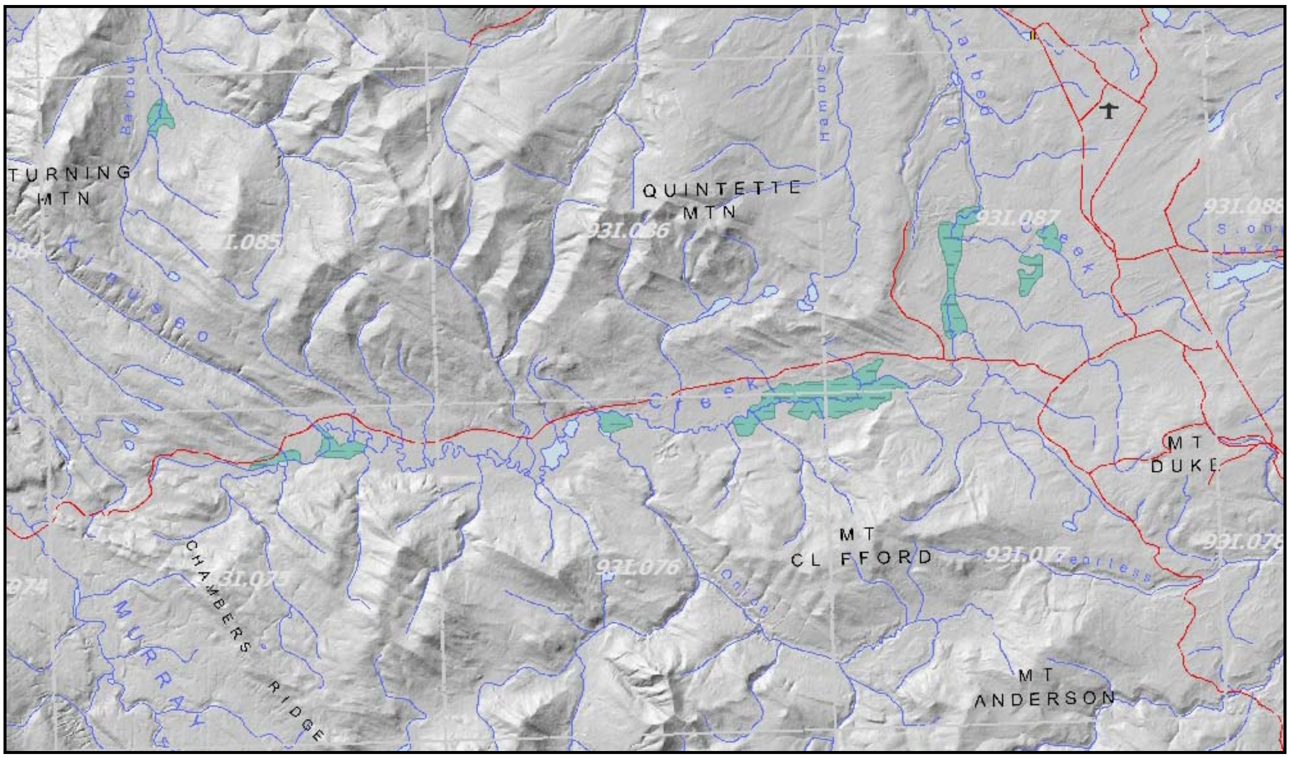

Figure G-3. Ground-truthing Area 1 (1:250,000).

Area 2 is located north of Fort St. John and covers the headwaters of several creeks draining north to the Sikanni Chief River and south to the Beaton River (Figure G-2). The area is covered in muskeg, with very few significant terrain features. Major drainages within the study area are Black Creek in the southwest, Wendy Creek in the east and Conroy Creek in the northwest. Area 2 is more remote than Area 1, with no obvious evidence of intensive historic land use other than recent forestry and petroleum industry developments. However, 21 documented archaeological sites, almost all lithic scatters, are located within the study area. The preliminary potential model for this area incorporates image classification results and the terrain model used throughout the Peace Forest District. Ground-truthing areas where image classification has been applied is a crucial component of this phase of the project.

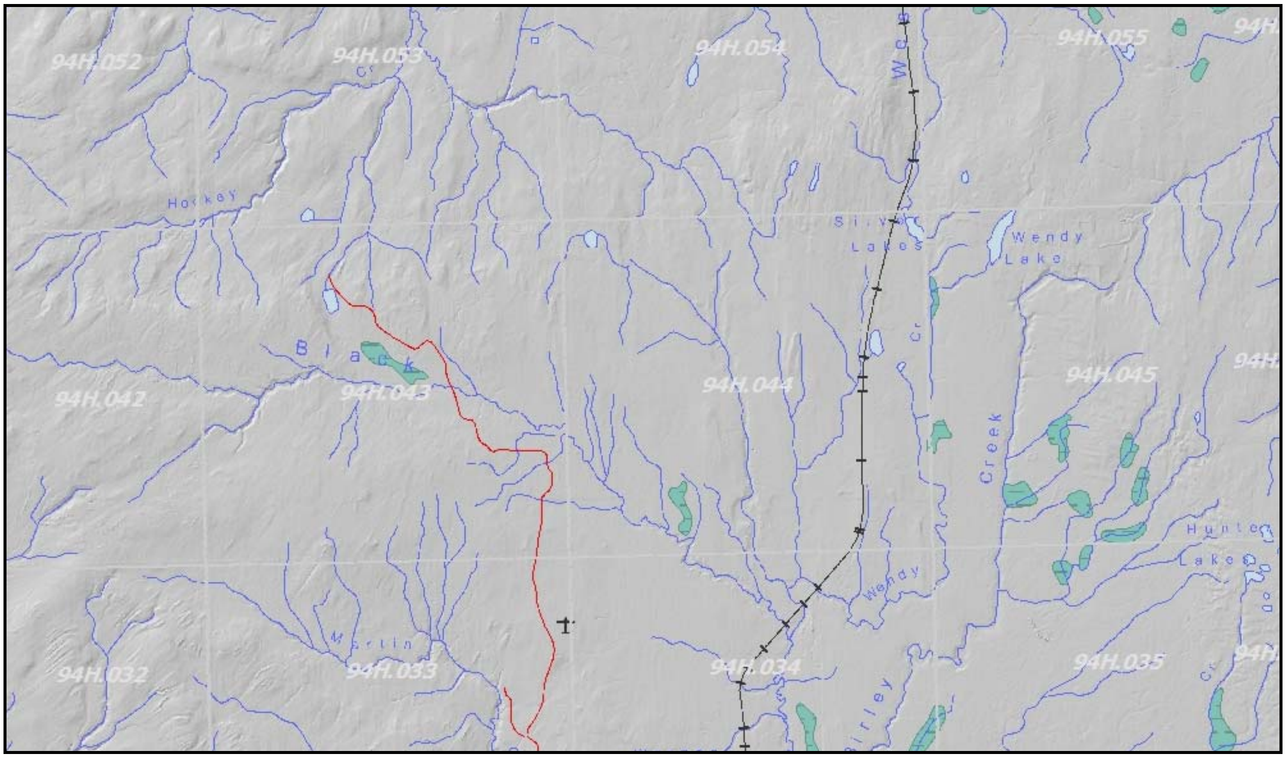

Figure G-4. Ground-truthing Area 2 (1:250,000).

2.3 First Nations Liaison and Participation

Written notification about the location of areas to be studied was provided prior to fieldwork to the appropriate Aboriginal communities. Prior to the fieldwork component of the AIS, the Aboriginal group(s) in whose territories the fieldwork was to take place were contacted by facsimile, e-mail, in-person, or telephone and encouraged to participate.

2.4 Field Methods

A crew consisting of one Arcas archaeologist, one assistant archaeologist and one member from each participating Aboriginal community conducted systematic (linear) and judgmental traverses by truck, all-terrain vehicle and foot throughout each section of study area. Crew members had 1:20,000 scale maps with the preliminary model (terrain model and image classification model separately, where applicable) superimposed over terrain information (contours, drainages, water bodies, and hill-shaded terrain representation). The crew also had two GPS units with the potential model and documented archaeological site overlays, in order to determine their precise location relative to modeled potential while in the field.

Generally, the crew followed existing roads, seismic lines and trails by all-terrain vehicle, recording observed potential in addition to forest cover, terrain descriptions and previous disturbance. Where moderate to high potential was observed in locations modeled as low potential, coordinates were determined using a GPS unit and detailed description of that location was recorded. Locations where modeled potential and observed archaeological potential matched were noted and described and GPS coordinates were recorded. Photos were taken of non-matching locations, archaeological site locations, cultural heritage sites (e.g., culturally modified trees and trails) and general environmental settings.

Although the primary goal of the ground-truthing is to assess the ability of the preliminary model to predict observed archaeological potential, all locations, regardless of potential assessment, received survey coverage including thorough inspection of the ground surface. Also, subsurface testing (e.g., shovel tests and trowel tests) at intervals ranging from 2 m to 15 m – depending on the size and configuration of the landform, surface exposure, vegetation (limiting factors would include standing trees and fallen trees), soil drainage quality, and other considerations – occurred when appropriate. In all surveyed lands, the surface was examined for archaeological features (food storage pits, hearths, etc.), artifacts, and other evidence of past settlement and land use, such as trails and culturally modified trees (CMTs).

Subsurface testing using shovels or trowels were used to locate buried archaeological remains. Subject to subsurface constraints, subsurface tests were excavated through all sediments likely to contain cultural materials to definitive non-archaeological sediments (e.g., glacial till). Subsurface tests minimally measured approximately 40 cm × 40 cm. Backdirt from the tests was examined manually or screened through 6 mm (or finer) mesh and all tests were backfilled upon completion.

3.0 RESULTS

Over 100 km of survey traverses covering a wide variety of terrain types, visits to 24 documented archaeological sites and several potential prehistoric trails were conducted between August 12th and 20th, 2008. The field crew consisted of Ewan Anderson and Jessica Ruskin (Arcas), Andrea Jackson (McLeod Lake Indian Band) and Ruby Apsassin (Blueberry River First Nation). A total of five days were spent in Area 1 and four days in Area 2. No new archaeological sites were identified.

At total of 80 non-matching locations were noted during fieldwork: 24 locations in Area 1 and 56 locations in Area 2. Although moderate to high archaeological potential was observed at 77 of these locations, the preliminary model indicated low potential. Three locations where the model indicated high archaeological potential were considered to have low archaeological potential by the field crew. In addition, 58 matching locations were noted: 31 locations in Area 1 and 27 locations is Area 2. Most locations (44) were noted where high potential landforms were observed and indicated by the potential model. Several matching low potential locations (14) were also noted. Observations at each non-matching or matching location are described in Appendix G Table 1. Factors that contribute to the non-matching potential values are discussed in Section 4.

3.1 Area 1 – Kinuseo Creek

3.1.1 Hambler Lakes

On the traverse from Flatbed Creek southwest to Hambler Lakes, the preliminary model captures high potential locations associated with slope breaks (*HiHi-004 & 005*) and water bodies or drainages (*HiHi-006 to 008*). However, the model misses several observed moderate to high potential slope-breaks, terraces and a large knoll (*HiLo-003* to *011*; Figure G-3; Photo G-1). In some cases (*HiLo-004*, *008* and *011*), observed moderate to high potential extends beyond high potential indicated by the preliminary model – only portions of those landforms considered to have high potential are captured (Figure G-3).

Photo G-1. View NE to large knoll at location HiLo-007.

No traditional trails were identified. A trail between Flatbed Creek at the Old Kinuseo Falls Road crossing and Upper Quintette Lake (indicated by background research) is not traversable or visible. No new archaeological sites were identified and no documented sites were revisited during this survey.

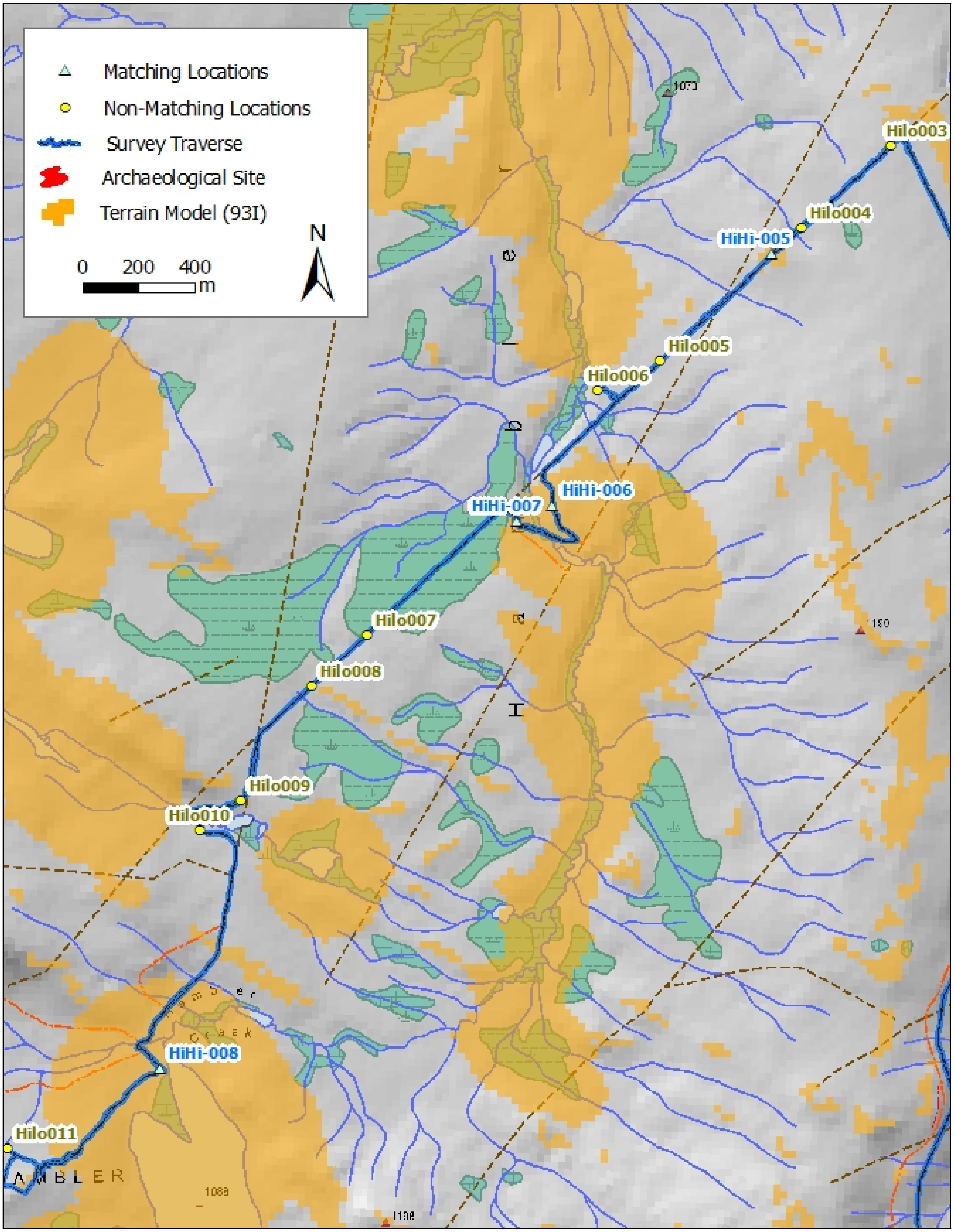

Figure G-5 Hambler Lakes survey coverage (1:20,000).

3.1.2 Flatbed Creek

The crew surveyed old roads, seismic lines and trails east and west of Flatbed creek, and revisited seven documented archaeological sites. West of Flatbed creek, one location (*HiLo-001*), consisting of a slope break on a southwest-aspect slope overlooking a wetland, was considered to have high archaeological potential (Photo 2). A total of 14 subsurface tests were excavated with negative results. Modeled high potential to southwest captures two archaeological sites (**GeRe-011** and **015** [*HiHi-009*]) and several high potential slope breaks adjacent to the wetland (Figure G-5). The preliminary model captures almost all moderate to high potential features along a north by south survey traverse including ridges (*HiHi-003*), slope breaks (*HiHi-002*) and small landforms near drainages (Figure G-4). The model omits low potential lands such as moderate to steep slopes (*LoLo-001*) and flat and featureless lands.

Photo G-2 View SW from location HiLo-001.

Near the north end of the traverse along the west side of Flatbed Creek, the model captures a slope break formed by a levelled wellsite pad (*HiLo-002*) for a-21-F / 93-I-15. Due to the level of disturbance, observed archaeological potential at this location is considered to be low. North of this location, the model captures observed high potential slope breaks, but only portions of moderate potential microtopographical landforms. Similarly, the model misses portions of slope breaks and small terrain features immediately west of Flatbed Creek (*HiLo-014*, *-015*, *-016*), including site **GeRe-007** (Figure G-5).

The model performs well east of Flatbed Creek, capturing terraces and slope breaks near Flatbed and Honeymoon Creek *(HiHi-001, -010*) including sites **GeRe-013** and -**014** *(HiHi-011*). The model also captures the top of a large hill (*HiHi-012*) within an old cutblock considered to have moderate-high archaeological potential. Further north, near site **GeRe-010**, several large features (terraces and slope breaks; *HiLo-017*, *-018*, *-019*) are modeled as low potential, while observed potential was high to very high. Terraces to either side of a deeply-incised tributary of Flatbed Creek are modeled as low potential (Photo G-3).

Photo G-3. Facing SW from site GeRe-010 to location HiLo-018.

No traditional trails were identified. Although several trails heading north and northeast from near the confluence of Honeymoon Creek and Flatbed Creek were indicated by background research, no trails or roads were traversable or visible during ground-truthing.

The crew was able to confirm the location of documented site **GeRe-007** by identifying shovel tests and flagging (not original). Mapped site locations for **GeRe-010**, **011**, **013**, **014**, **015** and **016** matched observed landform locations, but no other site indicators were observed (flagging or subsurface tests). These site locations can be considered to be accurate to within 20 m. No new archaeological sites were identified during this survey.

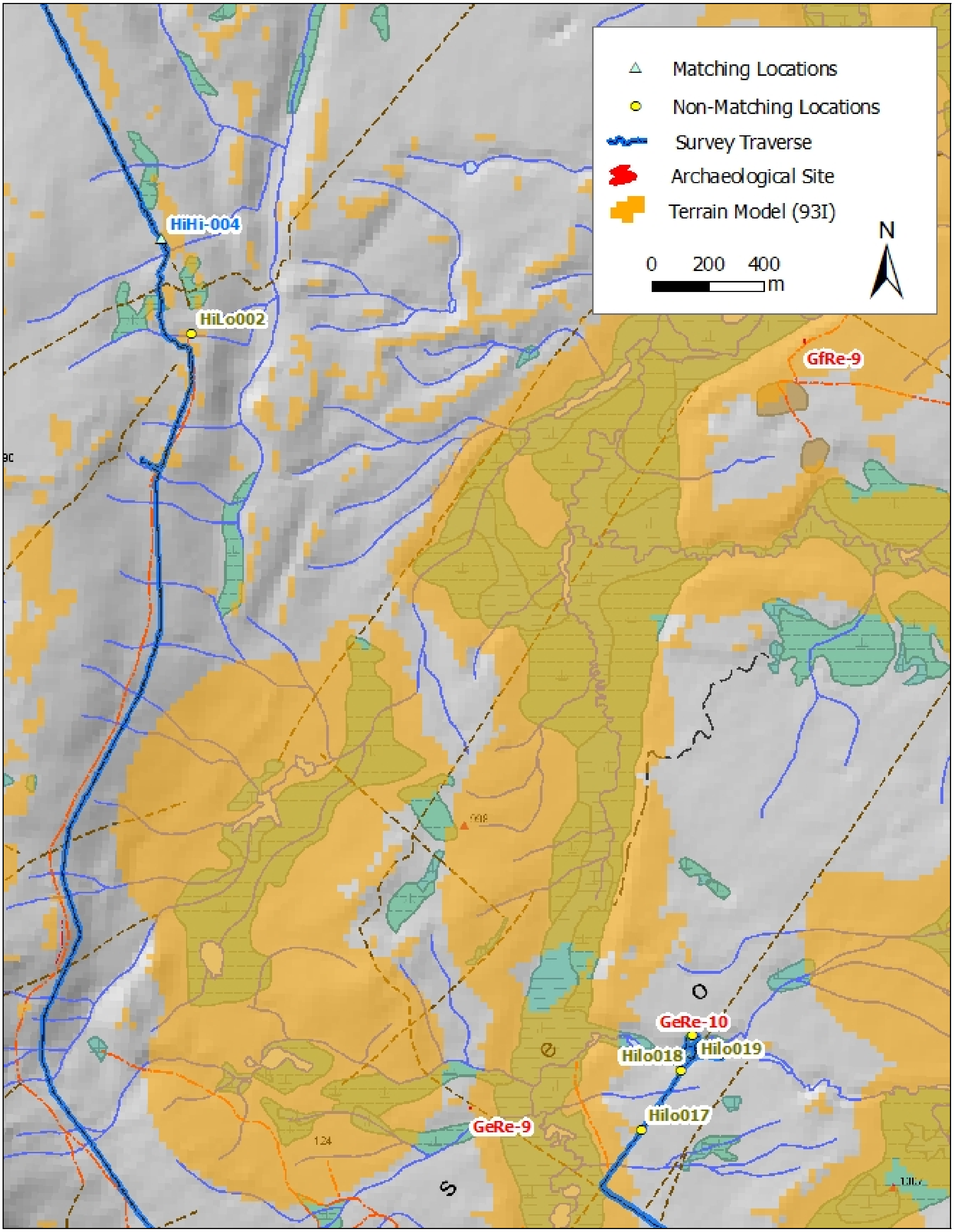

Figure G-6 Flatbed Creek (north) survey coverage (1:20,000).

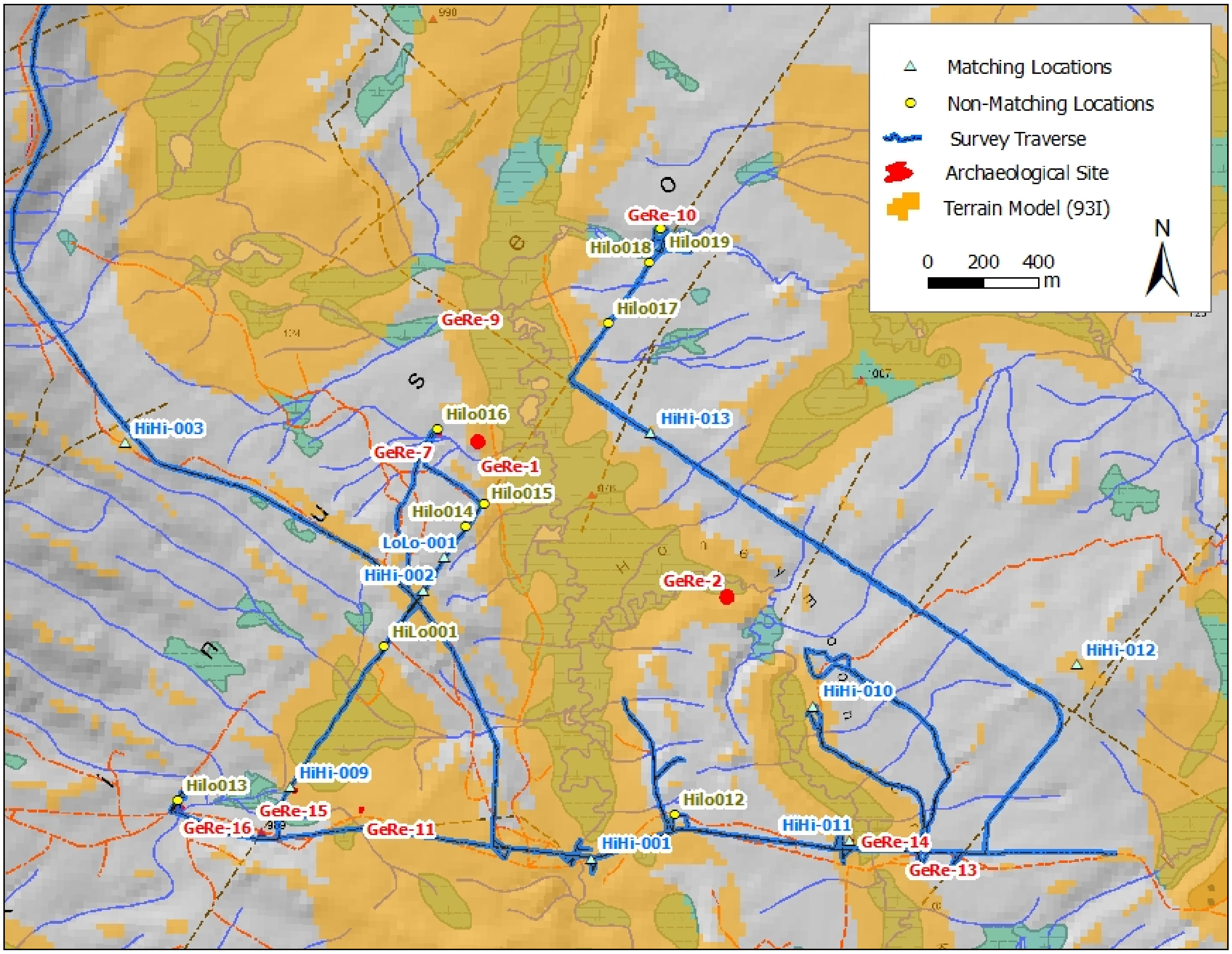

Figure G-7 Flatbed Creek (south) survey coverage (1:20,000).

3.1.3 Kinuseo Creek and Quintette Lake

The crew surveyed the Old Kinuseo Falls Road from the Kinuseo Creek crossing, 9 km east of the Murray River to Quintette Lake (Figures G-6 & G-7) and revisited eight documented archaeological sites. The road follows Kinuseo Creek, so most of the observed moderate and high potential lands are captured within the modeled high potential buffer on Kinuseo Creek (*HiHi-022, -023*). Exceptions include locations *HiLo-021* and *022*, where observed high potential and documented site location (**GeRf-001** and **-010**) do not match modeled low potential. In both cases, portions of high potential landforms (low-relief terraces or slope-breaks) are captured as high potential by the preliminary model.

An all-terrain vehicle trail, leading north from Old Kinuseo Falls Road was surveyed to the south end of Quintette Lake. Survey continued on foot to the north end of the Lake. The model captures most of the observed high potential slope-breaks and terraces along the trail (HiHi-024, 025). Observed moderate and high potential lands adjacent to Quintette Lake are captured by the preliminary model's buffer on the Lake (HiHi-026, -027). Two non-matching locations (HiLo-023 and -024) were tested (24 and 13 subsurface tests, respectively) with negative results. While the model captures a portion of location HiLo-023, approximately 90 m of observed high potential (creek terrace) is modeled as low potential.

Photo G-4. Cabin at the south end of Quintette Lake.

Photo G-5. Culturally Modified Tree at Quintette Lake.

The trail to Quintette Lake closely matches a trail identified during the background research for this project. The trailbed is well-defined and many trees along the trail have been blazed. One bark-stripped lodgepole pine was identified along the trail on the southeast side of Quintette Lake (Photo G-5). An increment core sample was taken, providing a modification date of 1911 A.D. (+/- 10 years). It is possible that the use of this trail dates to before the 20th century. However, north of the south end of Quintette Lake, the trail diverges into several footpaths, which are poorly-defined by the north end of the Lake.

The crew confirmed the location of documented site **GeRf-010** by identifying original flagging. Mapped site locations for **GeRf-001**, **-008**, **-009** and **-011** matched observed landform locations, but no other site indicators were observed (flagging or subsurface tests). Sites **GeRf-005** and **006** may be located close to their mapped location, but no discrete landforms indicate their precise location. Site **GeRf-004** is plotted in Quintette Lake and may actually be located approximately 200 m west of its mapped location.

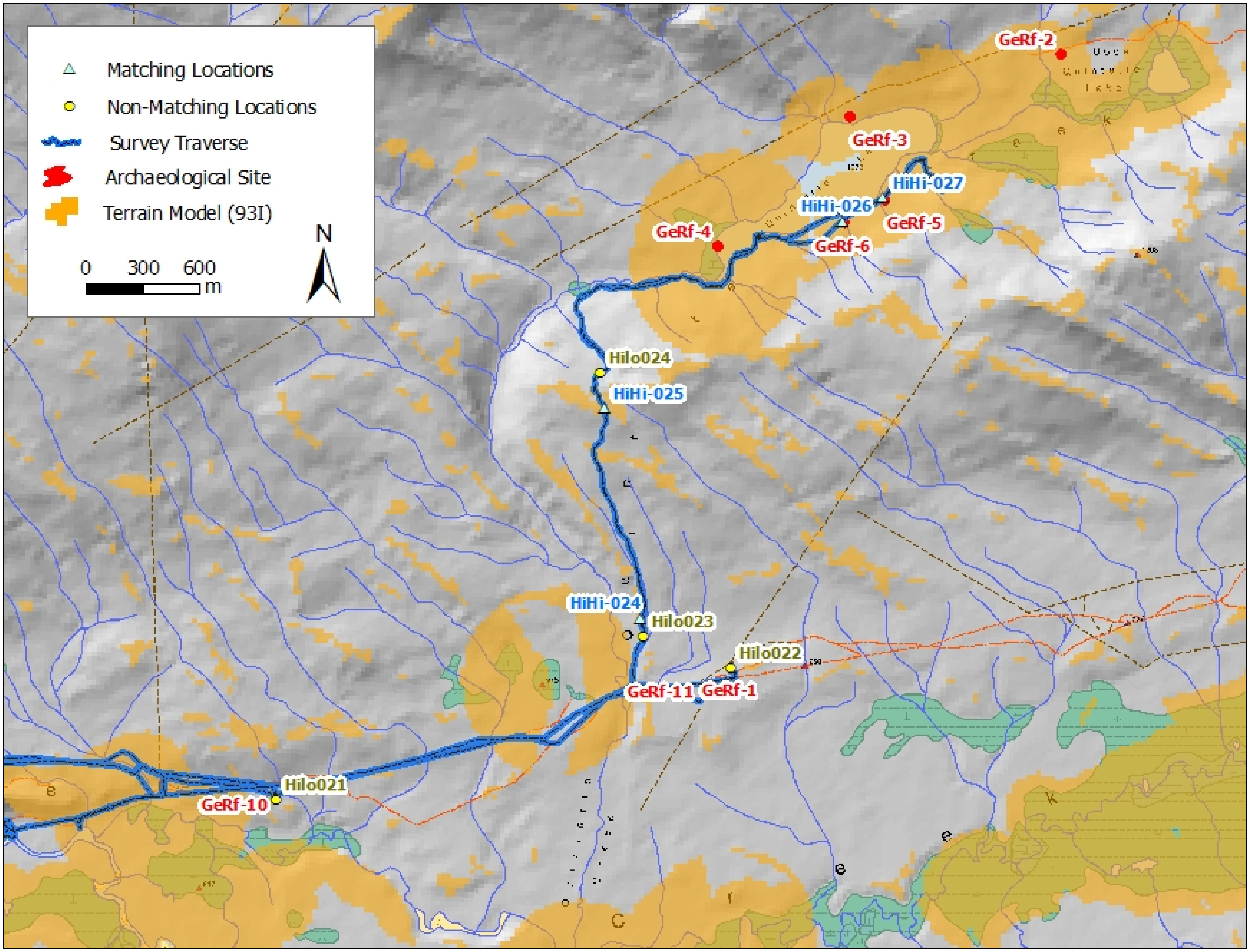

Figure G-8. Quintette Lake and Kinuseo Creek survey coverage (1:30,000).

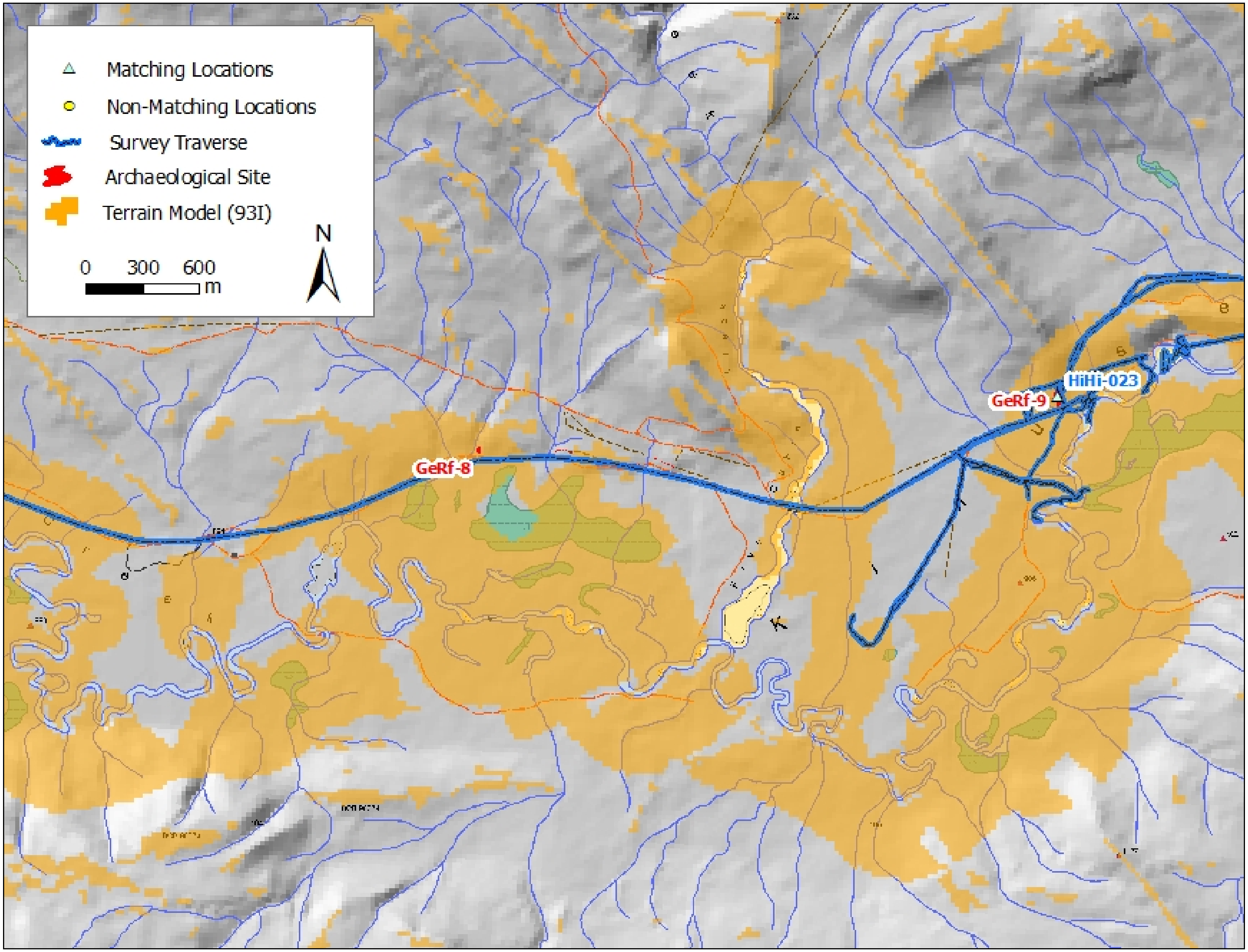

Figure G-9. Kinuseo Creek survey coverage (1:30,000).

3.1.4 Mount Clifford

One day of fieldwork was spent examining the preliminary model's performance in subalpine and alpine settings, around Mount Clifford. Terrain in this area is generally steep, with narrow ridges and hilltops providing clear views of small drainages, subalpine meadows, the Kinuseo Creek Valley to the north and the Onion Creek Valley to the south (Photo 6).

Photo G-6. View SW to Onion Creek from Mount Clifford.

The preliminary model captured all major slope breaks and observed high potential ridges and subalpine meadows (*HiHi-014* to *021*). Observed low potential also generally matched the model at locations with steep slopes or flat and featureless terrain (*LoLo-002* to *004*). One non-matching location, *HiLo-020*, is a levelled wellsite pad d-10-B / 93-I-15. Due to the level of disturbance, observed archaeological potential at this location is considered to be low. A survey south to lands adjacent to Onion Creek indicated that the preliminary model was capturing observed moderate and high potential, while most observed low potential lands were omitted from the model (Figure G-7).

No traditional trails were identified. No new archaeological sites were identified and no documented sites were revisited on this survey.

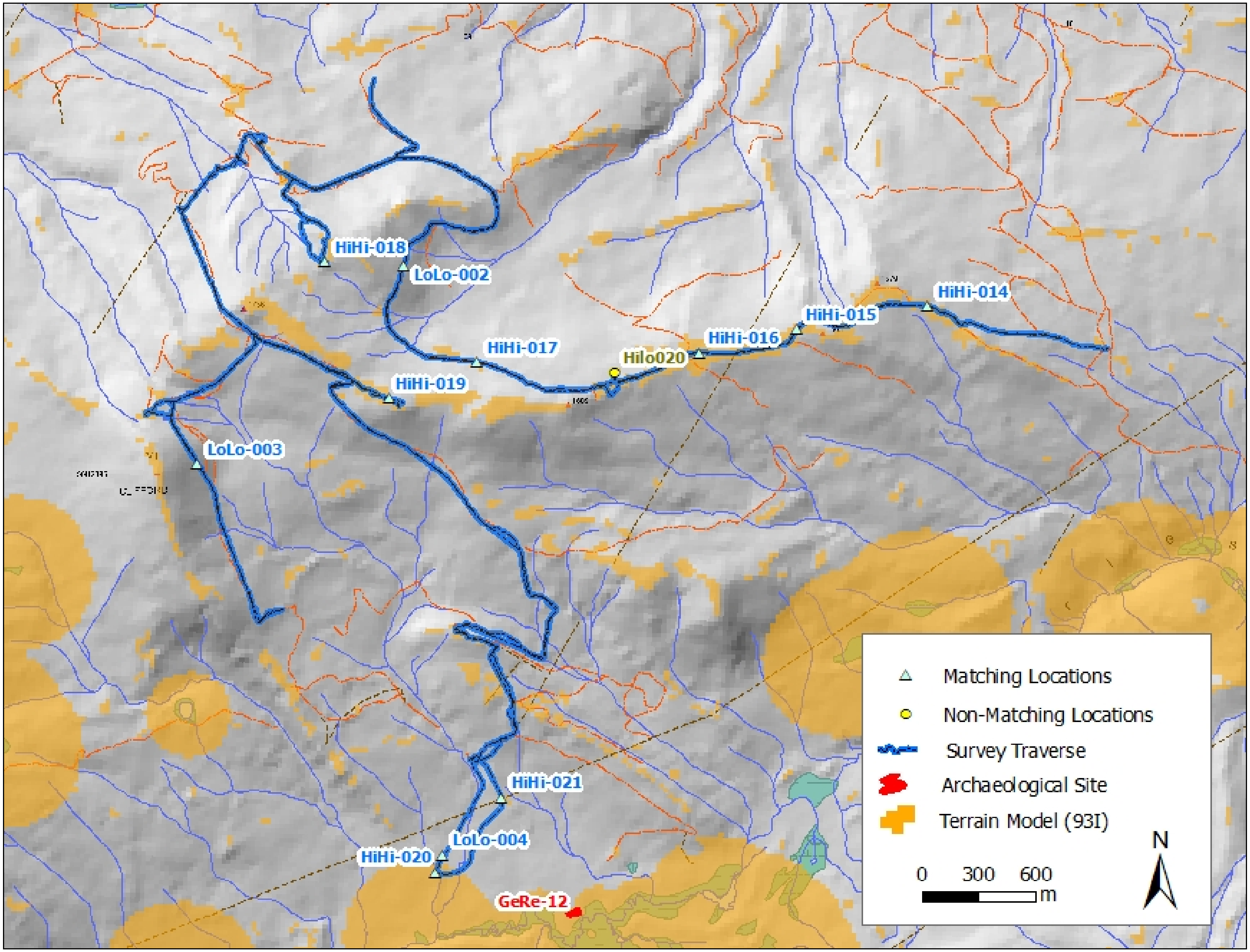

Figure G-10. Mount Clifford survey coverage (1:30,000).

3.2 Area 2 – Wargen Lakes

Well site access roads, pipeline rights-of-way and seismic lines were traversed by truck and all-terrain vehicle to assess the preliminary model in this area (Figures G-10 to G-16). A total of nine documented archaeological sites were revisited to confirm their locations.

Generally the terrain model alone does not perform well in this type of environmental setting. Observed moderate and high potential landforms are low-elevation and poorly-defined. Almost all non-matching locations are associated with these types of landforms. Most drainages are also poorly defined and bounded by large expanses of wetland considered to have low archaeological potential. Although large areas of low potential, muskeg are omitted from modeled high potential coverage (*LoLo-005* to *014*), a large portion of the modeled high potential lands are associated with these observed low potential wetlands (*HiLo-069*).

However, a number of non-matching locations (*HiLo-041*, *-045*, *-046*, *-052*, *-064*, *-067* and *-068*) are located on landforms that are partially captured by the terrain model. Three of the nine documented archaeological sites revisited are captured either wholly or partially by the terrain model (HiRh-004 at HiHi-041, HjRi-005 at HiHi-034 and HjRi-006 at HiHi-035). The model also matched observed archaeological potential at high potential locations associated with ridges, knolls and creek terraces (HiHi-028 to 044).

The image classification model captures more of the small, poorly-defined landforms considered to have high archaeological potential (Figure G-9). There are nine non-matching locations that are not captured by the terrain model that are captured (within 25 m) by image classification polygons (*HiLo-030*, *-036*, *-044*, *-047*, *-062*, *-064*, *-067*, *-068* and *-071*). This number could be higher if the image classification model was available for all Area 2 lands assessed.

Figure G-11. Image classification and terrain model on orthophoto (1:5,000).

The crew confirmed the location of documented archaeological sites **HjRi-005**, **-006** and **-007** by identifying original flagging or subsurface test pits (Photo G-7). Mapped site locations for **HiRh-002**, **-003**, **-004**, **-007**, **HiRi-002** and **HjRh-007** matched observed landform locations, but no other site indicators were observed (flagging or subsurface tests).

Photo G-7. View SSW to site HjRi-007.

No traditional trails were identified. No new archaeological sites were identified and no documented sites were revisited on this survey.

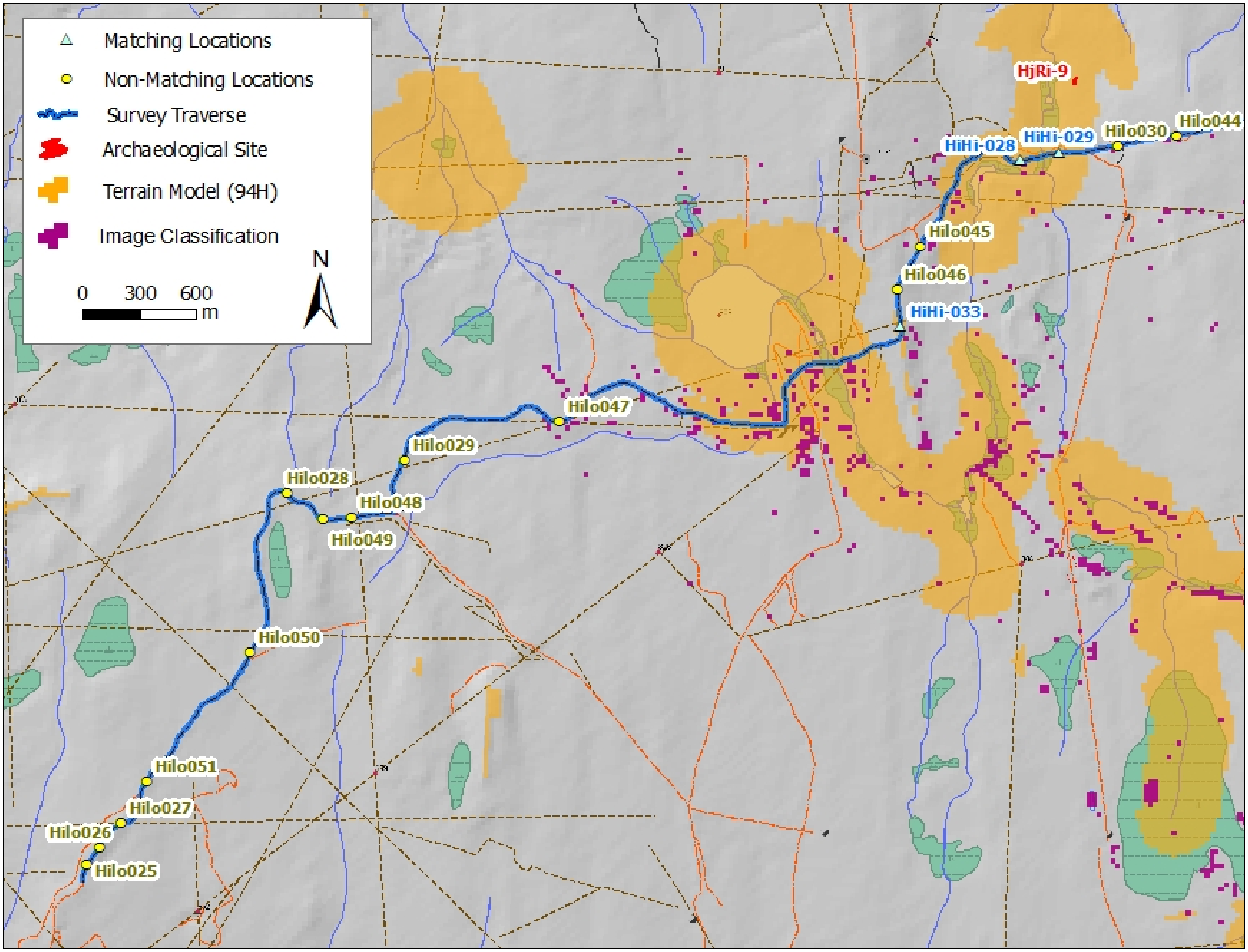

Figure G-12. Wargen Lakes survey coverage (1:30,000).

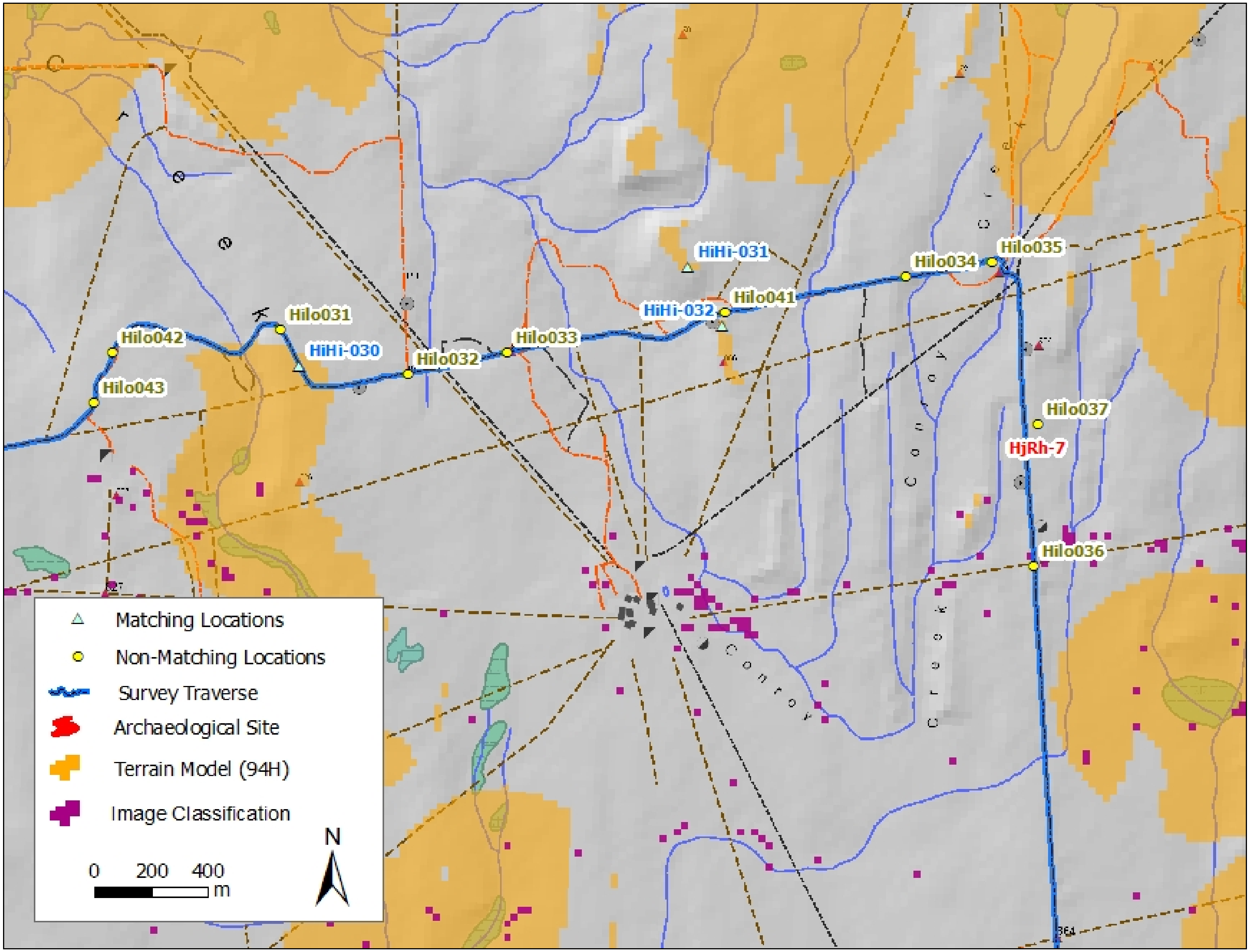

Figure G-13. Wargen Lakes survey coverage (1:20,000).

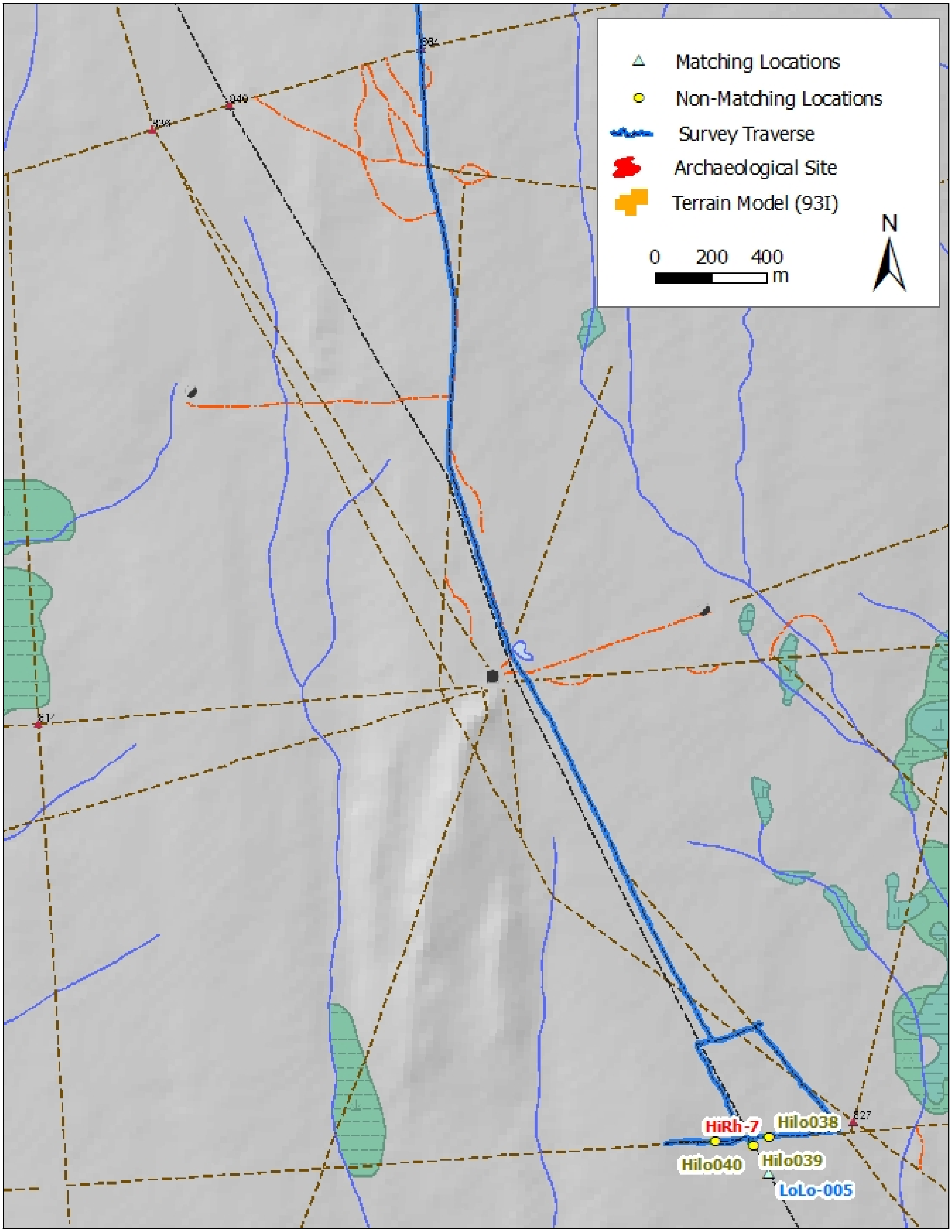

Figure G-14. Wargen Lakes survey coverage (1:20,000).

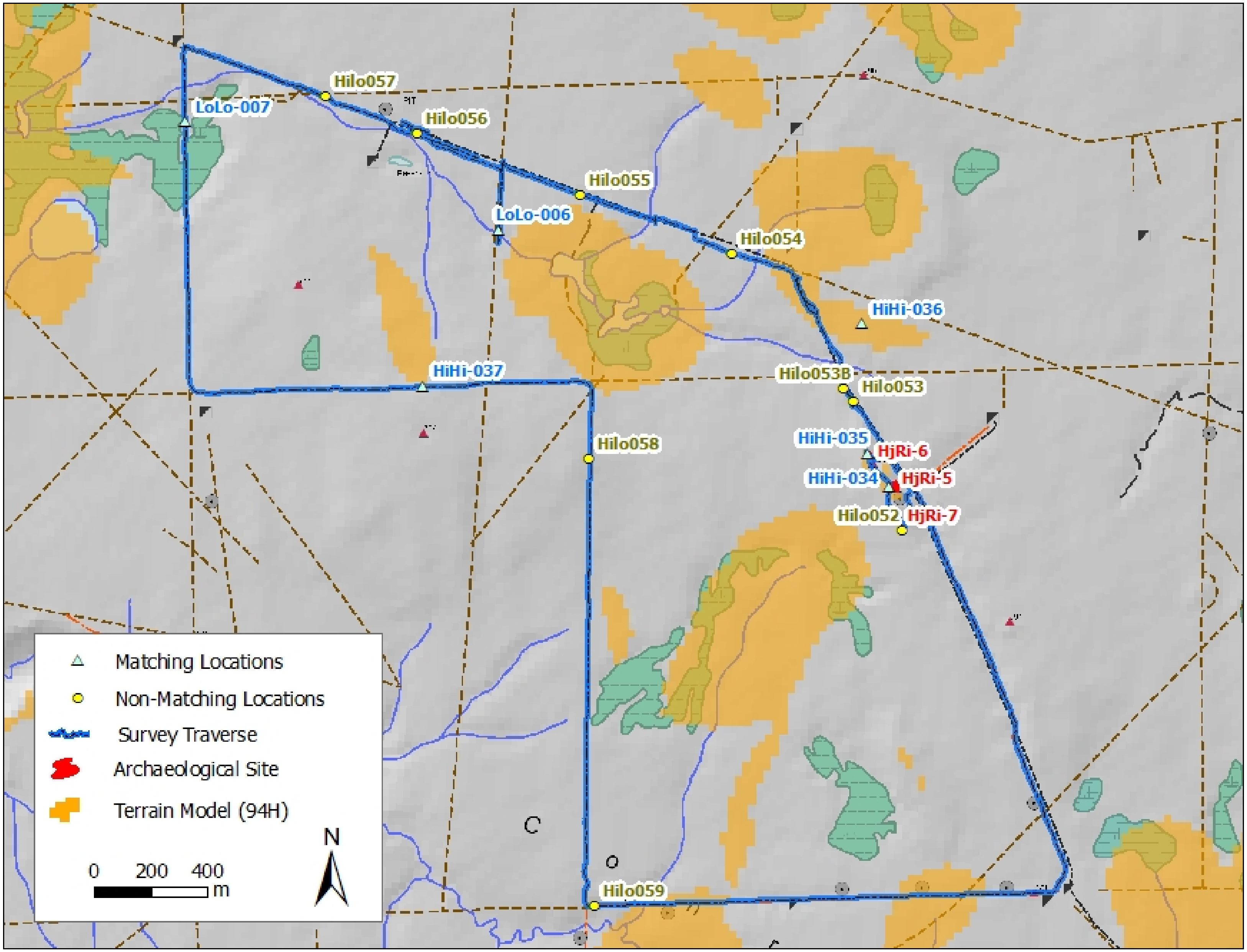

Figure G-15. Wargen Lakes survey coverage (1:20,000).

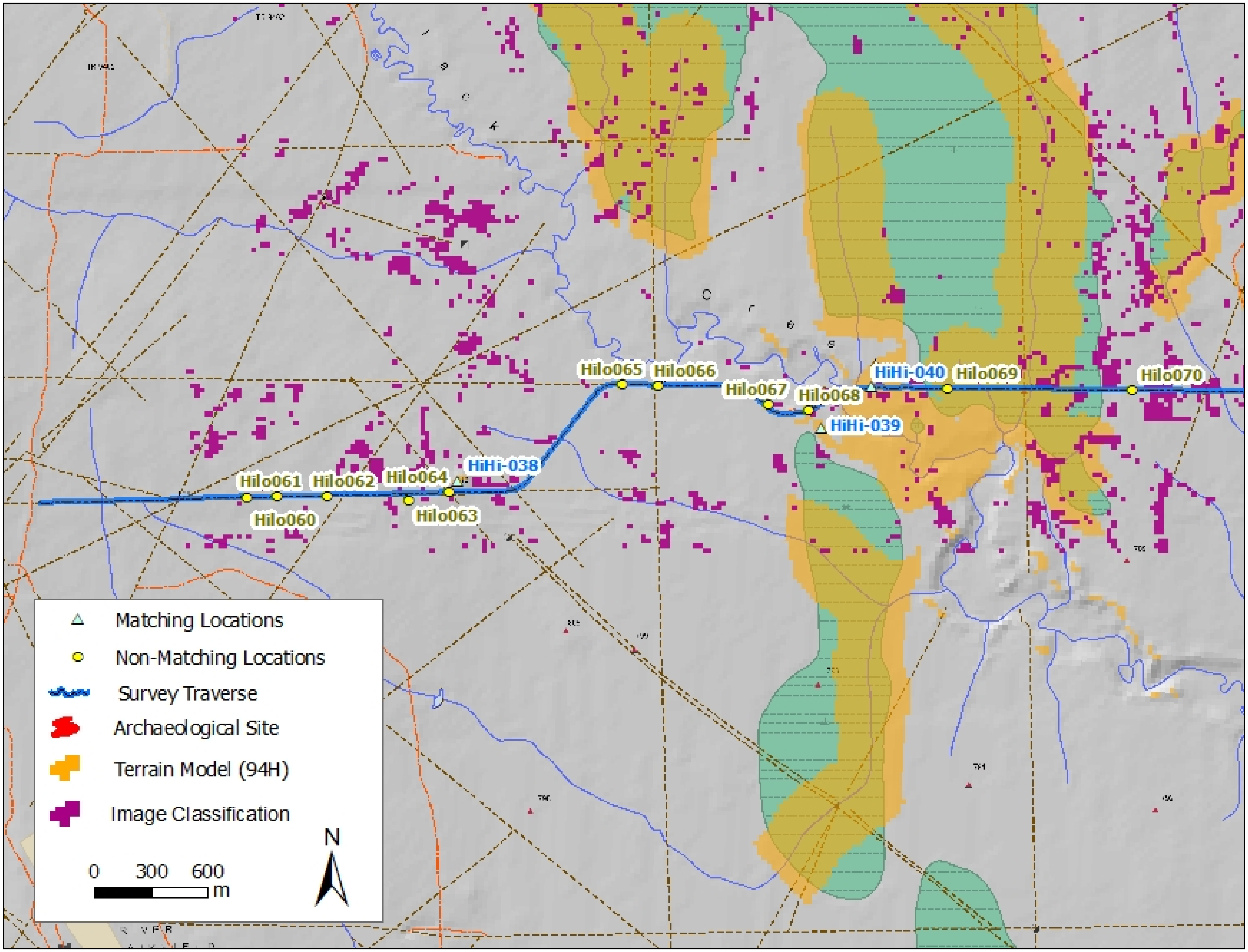

Figure G-16. Wargen Lakes survey coverage (1:30,000).

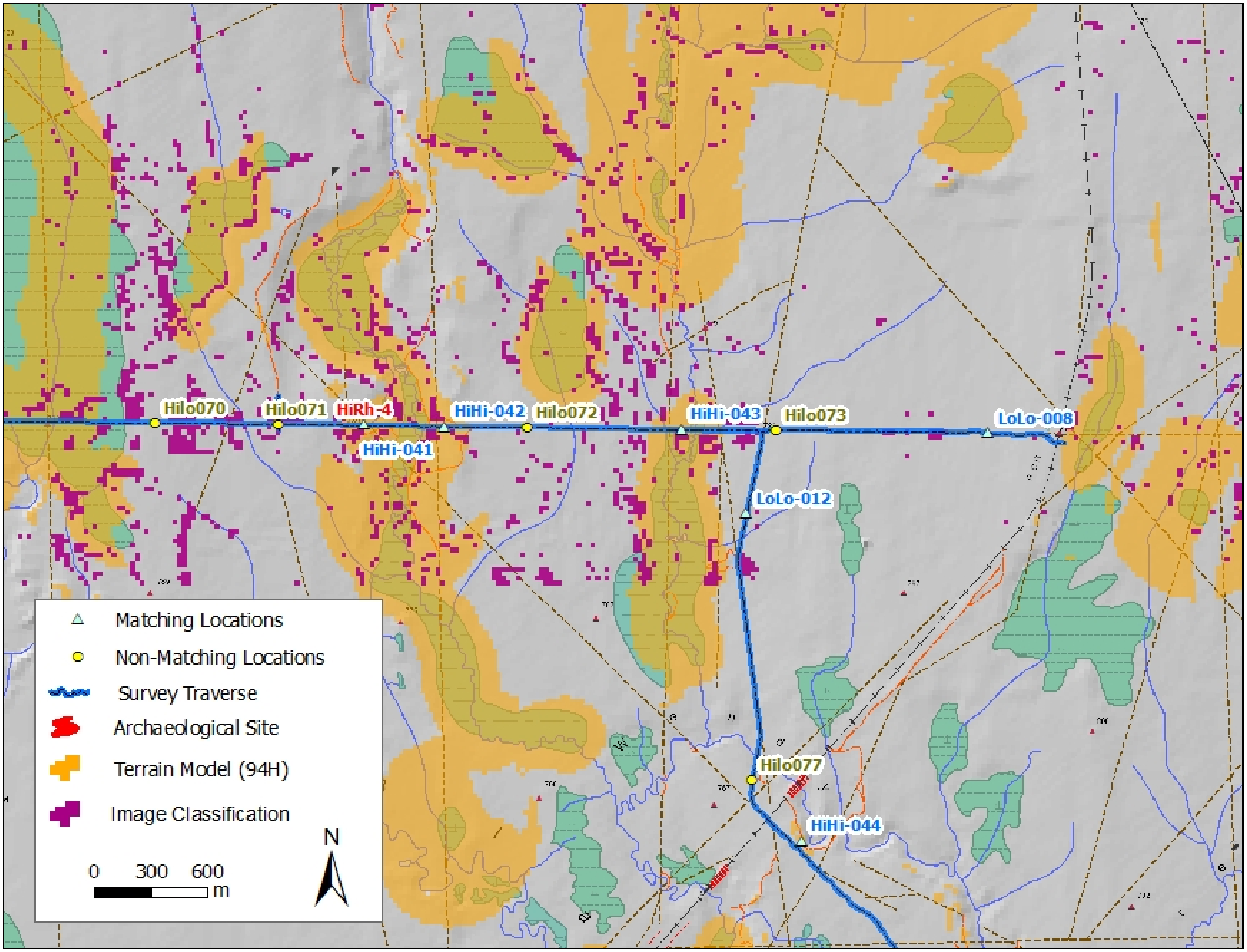

Figure G-17. Wargen Lakes survey coverage (1:30,000).

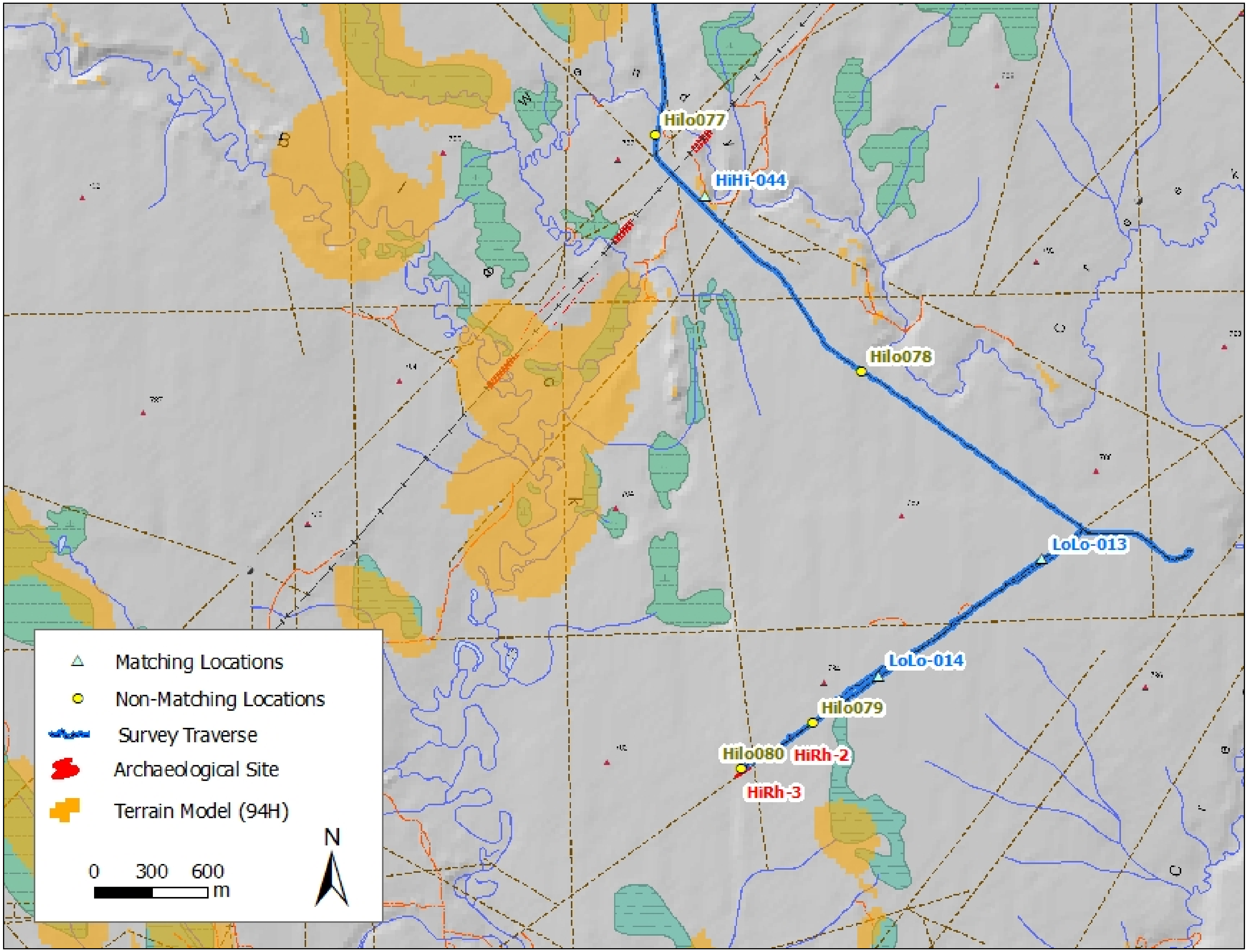

Figure G-18. Wargen Lakes survey coverage (1:30,000).

4.0 DISCUSSION

4.1 Model Performance

Generally, the terrain model performs well in high-relief settings. Despite the amount of area covered by the survey crew in Area 1, very few locations were identified, where the modeled potential values did not match observed potential. In many cases the non-matching observed high potential locations in Area 1 were on landforms that were *partially* captured by the model. The polygons that represent these small landforms form a relatively small portion of the total area captured by the model when compared the area captured by water body or drainage buffers. If these small polygons could be buffered by an arbitrary distance, we might see an improvement in model performance.

A few observed high potential locations are located next to drainages or water bodies that are not buffer by the preliminary model. In order to determine the best way to capture these locations, we must determine why these seemingly significant drainages are not captured in the preliminary model.

In Area 2 the model generally performs poorly, but with the addition of image classification polygons some improvements in performance were made. In general, the image classification polygons used were too small and some buffering may be required to capture whole landforms, or larger portions of observed high potential features. Conversely, some filtering is probably necessary to reduce isolated pixels, which may represent false-positives. Unfortunately, only a small sample of the area surveyed included image classification modeling – more ground-truthing is required to determine how the image classification application relates to observed archaeological potential.

4.2 Site Location Corrections

Very little new information has been acquired to help understand how best to use documented site data to test any archaeological potential model. Testing the model using this data is adversely affected by misplotted site polygons. A prior assumption that the accuracy of site locations decreases with the date that they were recorded is supported by the current field studies. Sites recorded in the 1980's can be misplotted by 200 m or more, while sites recorded since 2005 are accurate to within as little as 5 m. In order to get the most accurate performance statistics for the current and future archaeological potential models, a subset of documented archaeological sites must be used. Older and generally, less accurate data must be omitted entirely. Correcting site locations through further field survey or research is beyond the scope of this project.

4.3 Traditional Use Data

The results of the ground-truthing indicate a significant discrepancy between mapped traditional trails and trail locations on the ground. If we are to analyse the role traditional use sites (including trails) play in predicting archaeological potential in the Peace Forest District, we must first collect accurate location data. At the moment, most mapped trail locations cannot be confirmed to within 500 m. Other types of traditional use site may also contribute to the potential model, if they are accurately mapped. Non-protected CMT sites, for instance may indicate high potential for subsurface sites in settings that would otherwise receive a low potential rating based on terrain alone.

5.0 SUMMARY/NEXT STEPS

This report summarises the results of the first stage of ground-truthing. The preliminary Peace AOA model performs well in high-relief settings (large, well-defined landforms) and settings where drainages are significant and well defined. However, a model based exclusively on TRIM elevation data performs poorly in areas of low relief – that is, within the boreal plain. The results of the first round of ground truthing indicate that image classification software can extract features that closely correspond to microtopographical landforms in the muskeg.

The terrain model could be further refined to improve performance: small, linear polygons found to indicate slope breaks and terraces could be buffered to cover a larger portion of these high potential landforms. A similar strategy of buffering small linear polygons could be employed to the image classification results. However, further ground-truthing to identify the extent of false positives from image classification coverage is necessary before any buffering is completed.

Any subsequent fieldwork should involve the identification of traditional use sites. These sites, especially trails, should be recorded using a GPS and a degree of confidence in their authenticity. Although it is beyond the scope of this project to correct all site location data within the Peace Forest District, it is beneficial to confirm the location of documented archaeological sites whenever possible during ground-truthing.

Appendix G – Table 1

Location Number	Northing	Easting	Terrain Description	Forest Cover	Terrain Model Potential	Image Class. Model Potential	Observed Potential	Archaeological Site	Comment
HiLo001	6076586	644923	slope break, SW aspect	At_SwPl	LOW		HIGH		
HiLo002	6080604	644120	disturbed well pad		HIGH		LOW		
Hilo003	6081874	643489	slope break, SW aspect, level hilltop	PlSw_At	LOW		MOD-HIGH		
Hilo004	6081577	643170	ridge, NW trending	PlSwAt	LOW		MOD-HIGH		buffer existing TM polygon
Hilo005	6081100	642661	terrace, small, level, either side of creek	Pl_SwAt	LOW		MOD-HIGH		drng not in TRIM, landform too small?
Hilo006	6080998	642440	terrace ovrlook wtlnd, 2 m high	Pl_SwAt	LOW		HIGH		buffer TRIM drng and wtld to capture terrace
Hilo007	6080120	641611	knoll, 5 m high surrounded by flt,ftrls terrn	PlAt	LOW		HIGH		small high pot pixel filtered-out?
Hilo008	6079936	641412	terrace ovrlook wtlnd, 2 m high	At_Pl	LOW		HIGH		buffer or extend existing TM polygon
Hilo009	6079523	641158	terrace ovrlook small lake and wtlnd	At	LOW		HIGH		buffer small waterbody
Hilo010	6079419	641014	terrace ovrlook small lake and wtlnd	Pl	LOW		HIGH		buffer small waterbody
Hilo011	6078273	640322	ridge ovrlook small drng	Pl	LOW		MOD-HIGH		buffer TRIM drng or existing TM polygon
Hilo012	6075982	645969	slope break, W aspect, near drng	PlAt	LOW		HIGH		extend TRIM drng pot polygon buffer
Hilo013	6076030	644182	ridge, 5 m high, WNW toe, ovrlook drng	Pl_SwAt	LOW		HIGH	GeRe_016	buffer TRIM drng or existing TM polygon
Hilo014	6077015	645217	ridge, large NW by SW	At_SwPl	LOW		MOD-HIGH		buffer existing TM polygon
Hilo015	6077097	645281	ridge, large NW by SW		LOW		MOD-HIGH		landform too small?
Hilo016	6077369	645117	knoll, 4 m high ovrlook drng to S		LOW		HIGH	GeRe_007	similar landforms in surrounding area - influence DEM points?
Hilo017	6077750	645733	slope break, ovrlook signt drng	Pl	LOW		HIGH		extend existing TM polygon
Hilo018	6077963	645876	terrace ovrlook signt drng, 5 m high	Pl	LOW		HIGH		buffer TRIM drng
Hilo019	6078086	645919	terrace ovrlook signt drng, 5 m high	Pl	LOW		HIGH	GeRe-010	buffer TRIM drng
Hilo020	6070241	645390	disturbed well pad		HIGH		LOW		
Hilo021	6074297	634841	ridge, 50 m E by W, 2 m high, ovrlook small drng	SwPl	LOW		HIGH	GeRf-021	buffer TRIM drng or existing TM polygons
Hilo022	6075003	637249	gentle slope, ovrlook wtlnd	SwAt	LOW		LOW-MOD	GeRf-001	site misplotted?
Hilo023	6075171	636786	terrace, ovrlook drng	At_Pl	LOW		HIGH		buffer existing TM polygon,

Appendix G – Table 1

Location Number	Northing	Easting	Terrain Description	Forest Cover	Terrain Model Potential	Image Class. Model Potential	Observed Potential	Archaeological Site	Comment
									landform extends 90 m S
Hilo024	6076566	636559	ridge, small, ovrlook poorly-drained area	PlSw	LOW		HIGH		
Hilo025	6370578	593456	knoll, small	PlSwAt	LOW		MOD		small tone variation (At forest cov) on orthophoto
Hilo026	6370669	593524	knoll, small, 2 m high	PlSwAt	LOW		HIGH		small tone variation (At forest cov) on orthophoto
Hilo027	6370803	593639	knoll, large	PlAt_Sw	LOW		HIGH		large sect of At visible on orthophoto
Hilo028	6372551	594521	ridge, 3 m high, N by S	Pl	LOW		HIGH		large sect of At visible on orthophoto
Hilo029	6372730	595145	ridge, N by S, poorly-defined	Pl	LOW		HIGH		
Hilo030	6374399	598940	terrace on hillside	Pl	LOW	LOW	HIGH		buffer IC polygon or extend TRIM drng buffer
Hilo031	6374952	600687	ridge btn 2 drngs, 3 m high	SbPl	LOW		HIGH		buffer TRIM drng, available IC captures landform to S
Hilo032	6374797	601135	ridge btn 2 drngs, 2 m high	Sb_Pl	LOW		MOD-HIGH		buffer TRIM drng, large sect of At on ortho
Hilo033	6374870	601488	terrace ovrlook drng	Sb_Pl	LOW		MOD		buffer TRIM drng
Hilo034	6375140	602897	ridge, large	At	LOW		HIGH		buffer TRIM drng
Hilo035	6375193	603202	ridge, N by S, 4 m high, ovrlook drng	At_SwPl	LOW		HIGH		buffer TRIM drng
Hilo036	6374116	603348	ridge, poorly-defined 3-5 m high	PlSb	LOW	LOW	HIGH		buffer IC polygon - 2 IC pixels within 25 m
Hilo037	6374615	603365	slope break, W of poorly-drained area	PlSb	LOW		HIGH	HjRh-007	
Hilo038	6368892	604682	knoll, 1.5 m high, 5 by 10 m	Sb_Pl	LOW	LOW	HIGH	HiRh-007	very poor quality ortho
Hilo039	6368864	604626	knoll, 2 m high, 10 by 20 m	Sb_Pl	LOW	LOW	HIGH		very poor quality ortho
Hilo040	6368878	604491	knoll, less than 1 m high	Sb_Pl	LOW	LOW	MOD		very poor quality ortho
Hilo041	6375013	602257	slope break ovrlook drng	SbSw_Pl	LOW		MOD-HIGH		buffer existing TM polygon
Hilo042	6374870	600091	slope break, top of hill, 300 m from drng	Sb_Pl	LOW		MOD		
Hilo043	6374693	600025	knoll, E end of 1.5 m high lndform	SwAt	LOW		MOD		too small for TRIM DEM
Hilo044	6374452	599255	slope break, top of 120 m wide hill	PlSw	LOW	LOW	MOD		buffer IC polygon - to E and W within 25 m
Hilo045	6373864	597885	ridge, S end N by S trending	Pl_Sb	LOW	LOW	MOD		buffer IC polygon - to E within 40 m, At visible on ortho
Hilo046	6373634	597763	ridge, S end of large N by S trending	Pl_Sw	LOW	LOW	HIGH		landform captured by TM to S

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Location Number	Northing	Easting	Terrain Description	Forest Cover	Terrain Model Potential	Image Class. Model Potential	Observed Potential	Archaeological Site	Comment
Hilo047	6372934	595970	ridge, poorly-defined ovrlook drng and wtlnd	Sb_Pl	LOW	HIGH	HIGH		captured by IC - within 3 m
Hilo048	6372424	594866	knoll, 4 m high	At	LOW		HIGH		in existing cutblock
Hilo049	6372412	594715	knoll	At	LOW		HIGH		in existing cutblock
Hilo050	6371705	594323	knoll, 5 m wide E by W		LOW		MOD		
Hilo051	6371025	593779	knoll, small - less than 1 m high	Sb_Pl	LOW		MOD		
Hilo052	6378978	597973	ridge, 5-10 m wide E by W	PlSw	LOW		HIGH		buffer existing TM polygons, landform captured by TM to north
Hilo053	6379432	597800	ridge, 6 m high, N by S trending	PlAt	LOW		HIGH		pattern on orthophoto may corresp to landform
Hilo053B	6379480	597765	ridge, 6 m high, N by S trending	PlAt	LOW		HIGH		W side of landform at Hilo053
Hilo054	6379958	597370	knoll, 0.5 m high, poorly-defined	Sb_Pl	LOW		MOD		too small for TRIM DEM
Hilo055	6380167	596833	knoll, 1 m high, poorly defined	Sb_Pl	LOW		MOD		extend TM (water) polygon - not ideal
Hilo056	6380382	596255	knoll, 1.5 m high, S end	Sb_Pl	LOW		MOD		buffer TRIM drng
Hilo057	6380513	595926	knoll, 1.5 m high	Sb_Pl	LOW		MOD		buffer TRIM drng
Hilo058	6379233	596862	slope break, edge of large hill	SwAt	LOW		MOD-HIGH		pattern on orthophoto may corresp to landform
Hilo059	6377646	596881	elevated terrain NW of drng	SwSb_Pl	LOW		MOD-HIGH		buffer TRIM drng
Hilo060	6363330	596200	ridge, 50 m N by S, 1.5 m high	Pl	LOW	LOW	HIGH		buffer IC polygon - to NE within 40 m, old burn
Hilo061	6363335	596360	ridge, 50 m N by S, 0.5 m high	Pl	LOW	LOW	HIGH		too small for TRIM DEM, old burn
Hilo062	6363340	596633	ridge, N by S trending, 0.5 m high	Pl	LOW	LOW	MOD		buffer IC polygon - to NW within 25 m, old burn
Hilo063	6363313	597060	ridge, 2-3 m high, E by W trending	PlAt	LOW	HIGH	HIGH		buffer IC polygons - IC only captures portion of landform
Hilo064	6363356	597273	ridge, S end of large N by S trending	At	HIGH	HIGH	HIGH		buffer IC and TM polygons - only portions of landform captured
Hilo065	6363930	598198	ridge, 2 m high, 40 m wide, N by S trending	Pl	LOW	LOW	HIGH		buffer TRIM drng - Black Creek, old burn
Hilo066	6363926	598387	terrace ovrlook drng, 1 m high	Pl	LOW	LOW	HIGH		buffer TRIM drng - Black Creek, old burn
Hilo067	6363821	598976	slope break ovrlook drng and muskeg	Pl	LOW	HIGH	MOD-HIGH		buffer TRIM drng and IC polygon - to E within 20 m
Hilo068	6363794	599186	ridge ovrlook drng, NNW by SSE trending	Pl	HIGH	HIGH	HIGH		buffer IC and TM polygons - only portions of landform

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Location Number	Northing	Easting	Terrain Description	Forest Cover	Terrain Model Potential	Image Class. Model Potential	Observed Potential	Archaeological Site	Comment
									captured
Hilo069	6363910	599925	flat and featureless, muskeg	Sb	HIGH	LOW	LOW		TRIM drng buffer is too big, drng to E is ephemeral
Hilo070	6363900	600910	ridge, 50 m wide, N by S trending, poorly-defined	Pl	LOW	LOW	MOD		too poorly defined for IC and DEM
Hilo071	6363895	601565	elevated terrain surrounded by muskeg	PlSw	LOW	HIGH	MOD		buffer IC polygon to cover roads, buffer TRIM drng
Hilo072	6363877	602889	ridge, 40 m wide, N by S trending, slightly elevated	PlSw	LOW	LOW	MOD		buffer IC polygns and TRIM drng to capture portion of landform
Hilo073	6363860	604217	slope break, 0.5 m high W-aspect slope	PLSw	LOW	LOW	MOD		too small for TRIM DEM
Hilo074	6359142	595474	slope break, gentle slope	Pl	LOW		MOD-HIGH		
Hilo075	6359136	595815	slope break, 3 m above riparian setting	Pl_AtSw	LOW		HIGH		buffer TRIM drng
Hilo076	6359151	596876	ridge, 100 m N by S, poorly-defined	Pl	LOW		MOD-HIGH	HiRi-002	pattern on orthophoto may correspond to landform, old burn
Hilo077	6362001	604083	slope break ovrlook drng	SwPl	LOW		HIGH		buffer TRIM drng - Wendy Creek
Hilo078	6360748	605174	knoll, slightly-elevated, poorly-defined	SwPl	LOW		MOD		buffer TRIM drng - Wendy Creek
Hilo079	6358880	604917	elevated terrain - N edge, adjacent to muskeg	Pl	LOW		MOD-HIGH	HiRh-002	buffer TRIM wtlnd and drng - not ideal
Hilo080	6358635	604535	knoll, 30 wide, less than 1 m high	Pl_Sb	LOW		MOD-HIGH	HiRh-003	pattern on orthophoto may correspond to landform
HiHi-001	6075820.5	645669.15	creek terrace	Pl	HIGH		HIGH		EA notes pg 1
HiHi-002	6076784.5	645063.35	Hilltop, slope break to NE	At, Pl	HIGH		HIGH		EA notes pg 1
HiHi-003	6077314.2	643992.01	ridge adjacent to ephemeral drainage	Pl, At	HIGH		MOD-HIGH		EA notes pg 2
HiHi-004	6080943.9	644012.96	slope break, NE aspect	At, Pl	HIGH		MOD-HIGH		EA notes pg 2
HiHi-005	6081485	643061.78	slope break, NW aspect	Pl	HIGH		HIGH		
HiHi-006	6080581.5	642275.97	slope break overlooking creek	Pl	HIGH		HIGH		EA notes pg 3
HiHi-007	6080525.9	642151.61	slope break overlooking creek	Pl	HIGH		HIGH		EA notes pg 3
HiHi-008	6078560	640868.38	level terrain overlooking lake	Pl	HIGH		HIGH		EA notes pg 4
HiHi-009	6076075.6	644585.78	large ridge overlooking wetland	Pl	HIGH		HIGH	GeRe-15	EA notes pg 5
LoLo-001	6076903.7	645139.56	moderately steep slope	At, Pl	LOW		LOW		EA notes pg 5
HiHi-010	6076368	646466.45	bench overlooking creek	Pl	HIGH		HIGH		JR notes pg 2

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Location Number	Northing	Easting	Terrain Description	Forest Cover	Terrain Model Potential	Image Class. Model Potential	Observed Potential	Archaeological Site	Comment
HiHi-011	6075886.4	646600.06	terrace overlooking creek	Pl	HIGH		HIGH	GeRe-14	
HiHi-012	6076517.4	647412.66	hilltop	Pl	HIGH		MOD-HIGH		JR notes pg 3
HiHi-013	6077349.9	645883.7	small section of level slope break	Pl, At	HIGH		HIGH		JR notes pg 3
HiHi-014	6070585.9	647052.89	crest of ridge	Pl, Sf	HIGH		MOD-HIGH		EA notes pg 7
HiHi-015	6070466.4	646355.3	crest of ridge	Pl, Sf	HIGH		MOD-HIGH		EA notes pg 7
HiHi-016	6070340.6	645836.09	crest of ridge	Pl, Sf	HIGH		MOD-HIGH		EA notes pg 7
HiHi-017	6070289.6	644662.31	slope break	Pl, Sf	HIGH		MOD-HIGH		EA notes pg 7
LoLo-002	6070800.9	644267.33	steep slope	Pl, Sf	LOW		LOW		EA notes pg 7
HiHi-018	6070823.2	643851.64	level subapline saddle adjacent to ephemeral drainage	Sf	HIGH		MOD-HIGH		EA notes pg 8
HiHi-019	6070100.1	644197.25	ridge near mountain summit with good views of valley	alpine	HIGH		MOD-HIGH		EA notes pg 8
LoLo-003	6069751.3	643171.58	steep slope	Sf, Pl	LOW		LOW		
HiHi-020	6067582.1	644440.93	elevated terrain adjacent to wetland	Pl, S	HIGH		MOD-HIGH		EA notes pg 8
HiHi-021	6067980.3	644791.31	small slope breaks on moderate slope	Pl, At	HIGH		HIGH		EA notes pg 8
LoLo-004	6067676.1	644479.15	flat and featureless wetand by creek	S(b), L	LOW		LOW		EA notes pg 8
HiHi-022	6073711.3	624425.25	bank of Kinuseo Creek	clearing	HIGH		HIGH		
HiHi-023	6073876.7	632763.16	terrace overlooking creek	Pl, At	HIGH		HIGH	GeRf-9	
HiHi-024	6075263.1	636771.61	terrace overlooking creek	Pl, At	HIGH		HIGH		EA notes pg 10
HiHi-025	6076377	636579.78	hilltop adjacent to bend in creek	Pl, S	HIGH		MOD-HIGH		EA notes pg 10
HiHi-027	6077497.5	638060.13	level or gently sloping terrain overlooking lake	Pl, Sf	HIGH		HIGH	GeRf-5	EA notes pg 10
HiHi-026	6077371.8	637843.17	level or gently sloping terrain overlooking lake	Pl, Sf	HIGH		HIGH	GeRf-6	EA notes pg 10
HiHi-028	6374316	598421.7	bench overlooking drainage	Pl	HIGH	HIGH	HIGH		EA notes pg 13
HiHi-029	6374359	598624.1	bench overlooking drainage	Pl	HIGH	LOW	HIGH		EA notes pg 13
HiHi-030	6374822	600751.3	ridge between 2 drainages	S(b), Pl	HIGH		HIGH		EA notes pg 14
LoLo-005	6368758	604682.6	flat and featureless muskeg	S(b)	LOW	LOW	LOW		EA notes pg 15
HiHi-031	6375172	602126.7	slope break above creek	S, Pl	HIGH		MOD-HIGH		EA notes pg 15
HiHi-032	6374963	602245.8	slope break above creek	S, Pl	HIGH		MOD-HIGH		EA notes pg 15
HiHi-033	6373436	597782.3	ridge	S, Pl	HIGH	HIGH	MOD-HIGH		EA notes pg 16
HiHi-034	6379132	597927.5	5-10 m wide N-S ridge	Pl, S, At	HIGH		HIGH	HjRi-5	EA notes pg 17
HiHi-035	6379247	597849.4	5-10 m wide N-S ridge	Pl, S	HIGH		HIGH	HjRi-6	EA notes pg 17

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Location Number	Northing	Easting	Terrain Description	Forest Cover	Terrain Model Potential	Image Class. Model Potential	Observed Potential	Archaeological Site	Comment
HiHi-036	6379708	597832.2	large ridge	Pl, At	HIGH		MOD-HIGH		EA notes pg 17
LoLo-006	6380040	596541	flat, featureless, poorly-drained	S(b)	LOW		LOW		
LoLo-007	6380424	595428.5	flat, featureless, poorly-drained	S(b)	LOW		LOW		EA notes pg 18
HiHi-037	6379486	596273.8	top of large hill	S	HIGH		MOD-HIGH		EA notes pg 18
HiHi-038	6363417	597326.1	ridge	At, S	HIGH	LOW	HIGH		JR notes pg 2of5
HiHi-039	6363693	599253.6	ridge overlooking Black Creek	Pl	HIGH	HIGH	HIGH		JR notes pg 3of5
HiHi-040	6363913	599523.5	terrace overlooking Black Creek	Pl	HIGH	HIGH	HIGH		
HiHi-041	6363889	602018.5	knolls and terraces overlooking creek	Pl, S	HIGH	HIGH	HIGH	HiRh-4	JR notes pg 4of5
HiHi-042	6363880	602447.1	knolls and terraces overlooking creek	Pl, S	HIGH	HIGH	HIGH		JR notes pg 4of5
HiHi-043	6363862	603707.9	ridge overlooking creek	Pl, S(b)	HIGH	HIGH	HIGH		JR notes pg 5of5
LoLo-008	6363843	605344.3	wetland	L, S(b)	LOW	LOW	LOW		JR notes pg 5of5
LoLo-009	6358489	597798.8	flat and featureless	S	LOW		LOW		EA notes pg 20
LoLo-010	6359173	597507.1	flat and featureless	S, (Pl)	LOW		LOW		EA notes pg 20
LoLo-011	6359760	597253.1	flat and featureless	S	LOW		LOW		EA notes pg 20
LoLo-012	6363419	604052.4	flat and featureless	S(b)	LOW	HIGH	LOW		EA notes pg 20
HiHi-044	6361678	604347.4	knolls and ridges	Pl, S	HIGH		HIGH		EA notes pg 20
LoLo-013	6359746	606134.6	wetland	S(b), L	LOW		LOW		EA notes pg 21
LoLo-014	6359126	605266.8	muskeg	S(b)	LOW		LOW		EA notes pg 21
HiLo001	6076586	644923	slope break, SW aspect	At_SwPl	LOW		HIGH		
HiLo002	6080604	644120	disturbed well pad		HIGH		LOW		
Hilo003	6081874	643489	slope break, SW aspect, level hilltop	PlSw_At	LOW		MOD-HIGH		
Hilo004	6081577	643170	ridge, NW trending	PlSwAt	LOW		MOD-HIGH		buffer existing TM polygon
Hilo005	6081100	642661	terrace, small, level, either side of creek	Pl_SwAt	LOW		MOD-HIGH		drng not in TRIM, landform too small?
Hilo006	6080998	642440	terrace ovrlook wtlnd, 2 m high	Pl_SwAt	LOW		HIGH		buffer TRIM drng and wtld to capture terrace
Hilo007	6080120	641611	knoll, 5 m high surrounded by flt,ftrls terrn	PlAt	LOW		HIGH		small high pot pixel filtered-out?
Hilo008	6079936	641412	terrace ovrlook wtlnd, 2 m high	At_Pl	LOW		HIGH		buffer or extend existing TM polygon
Hilo009	6079523	641158	terrace ovrlook small lake and wtlnd	At	LOW		HIGH		buffer small waterbody
Hilo010	6079419	641014	terrace ovrlook small lake and wtlnd	Pl	LOW		HIGH		buffer small waterbody
Hilo011	6078273	640322	ridge ovrlook small drng	Pl	LOW		MOD-HIGH		buffer TRIM drng or existing

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Location Number	Northing	Easting	Terrain Description	Forest Cover	Terrain Model Potential	Image Class. Model Potential	Observed Potential	Archaeological Site	Comment
									TM polygon
Hilo012	6075982	645969	slope break, W aspect, near drng	PlAt	LOW		HIGH		extend TRIM drng pot polygon buffer
Hilo013	6076030	644182	ridge, 5 m high, WNW toe, ovrlook drng	Pl_SwAt	LOW		HIGH	GeRe_016	buffer TRIM drng or existing TM polygon
Hilo014	6077015	645217	ridge, large NW by SW	At_SwPl	LOW		MOD-HIGH		buffer existing TM polygon
Hilo015	6077097	645281	ridge, large NW by SW		LOW		MOD-HIGH		landform too small?
Hilo016	6077369	645117	knoll, 4 m high ovrlook drng to S		LOW		HIGH	GeRe_007	similar landforms in surrounding area - influence DEM points?
Hilo017	6077750	645733	slope break, ovrlook signt drng	Pl	LOW		HIGH		extend existing TM polygon
Hilo018	6077963	645876	terrace ovrlook signt drng, 5 m high	Pl	LOW		HIGH		buffer TRIM drng
Hilo019	6078086	645919	terrace ovrlook signt drng, 5 m high	Pl	LOW		HIGH	GeRe-010	buffer TRIM drng
Hilo020	6070241	645390	disturbed well pad		HIGH		LOW		
Hilo021	6074297	634841	ridge, 50 m E by W, 2 m high, ovrlook small drng	SwPl	LOW		HIGH	GeRf-021	buffer TRIM drng or existing TM polygons
Hilo022	6075003	637249	gentle slope, ovrlook wtlnd	SwAt	LOW		LOW-MOD	GeRf-001	site misplotted?
Hilo023	6075171	636786	terrace, ovrlook drng	At_Pl	LOW		HIGH		buffer existing TM polygon, landform extends 90 m S
Hilo024	6076566	636559	ridge, small, ovrlook poorly-drained area	PlSw	LOW		HIGH		
Hilo025	6370578	593456	knoll, small	PlSwAt	LOW		MOD		small tone variation (At forest cov) on orthophoto
Hilo026	6370669	593524	knoll, small, 2 m high	PlSwAt	LOW		HIGH		small tone variation (At forest cov) on orthophoto
Hilo027	6370803	593639	knoll, large	PlAt_Sw	LOW		HIGH		large sect of At visible on orthophoto
Hilo028	6372551	594521	ridge, 3 m high, N by S	Pl	LOW		HIGH		large sect of At visible on orthophoto
Hilo029	6372730	595145	ridge, N by S, poorly-defined	Pl	LOW		HIGH		
Hilo030	6374399	598940	terrace on hillside	Pl	LOW	LOW	HIGH		buffer IC polygon or extend TRIM drng buffer
Hilo031	6374952	600687	ridge btn 2 drngs, 3 m high	SbPl	LOW		HIGH		buffer TRIM drng, available IC captures landform to S
Hilo032	6374797	601135	ridge btn 2 drngs, 2 m high	Sb_Pl	LOW		MOD-HIGH		buffer TRIM drng, large sect of At on ortho
Hilo033	6374870	601488	terrace ovrlook drng	Sb_Pl	LOW		MOD		buffer TRIM drng
Hilo034	6375140	602897	ridge, large	At	LOW		HIGH		buffer TRIM drng

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Location Number	Northing	Easting	Terrain Description	Forest Cover	Terrain Model Potential	Image Class. Model Potential	Observed Potential	Archaeological Site	Comment
Hilo035	6375193	603202	ridge, N by S, 4 m high, ovrlook drng	At_SwPl	LOW		HIGH		buffer TRIM drng
Hilo036	6374116	603348	ridge, poorly-defined 3-5 m high	PlSb	LOW	LOW	HIGH		buffer IC polygon - 2 IC pixels within 25 m
Hilo037	6374615	603365	slope break, W of poorly-drained area	PlSb	LOW		HIGH	HjRh-007	
Hilo038	6368892	604682	knoll, 1.5 m high, 5 by 10 m	Sb_Pl	LOW	LOW	HIGH	HiRh-007	very poor quality ortho
Hilo039	6368864	604626	knoll, 2 m high, 10 by 20 m	Sb_Pl	LOW	LOW	HIGH		very poor quality ortho
Hilo040	6368878	604491	knoll, less than 1 m high	Sb_Pl	LOW	LOW	MOD		very poor quality ortho
Hilo041	6375013	602257	slope break ovrlook drng	SbSw_Pl	LOW		MOD-HIGH		buffer existing TM polygon
Hilo042	6374870	600091	slope break, top of hill, 300 m from drng	Sb_Pl	LOW		MOD		
Hilo043	6374693	600025	knoll, E end of 1.5 m high lndform	SwAt	LOW		MOD		too small for TRIM DEM
Hilo044	6374452	599255	slope break, top of 120 m wide hill	PlSw	LOW	LOW	MOD		buffer IC polygon - to E and W within 25 m
Hilo045	6373864	597885	ridge, S end N by S trending	Pl_Sb	LOW	LOW	MOD		buffer IC polygon - to E within 40 m, At visible on ortho
Hilo046	6373634	597763	ridge, S end of large N by S trending	Pl_Sw	LOW	LOW	HIGH		landform captured by TM to S
Hilo047	6372934	595970	ridge, poorly-defined ovrlook drng and wtlnd	Sb_Pl	LOW	HIGH	HIGH		captured by IC - within 3 m
Hilo048	6372424	594866	knoll, 4 m high	At	LOW		HIGH		in existing cutblock
Hilo049	6372412	594715	knoll	At	LOW		HIGH		in existing cutblock
Hilo050	6371705	594323	knoll, 5 m wide E by W		LOW		MOD		
Hilo051	6371025	593779	knoll, small - less than 1 m high	Sb_Pl	LOW		MOD		
Hilo052	6378978	597973	ridge, 5-10 m wide E by W	PlSw	LOW		HIGH		buffer existing TM polygons, landform captured by TM to north
Hilo053	6379432	597800	ridge, 6 m high, N by S trending	PlAt	LOW		HIGH		pattern on orthophoto may corresp to landform
Hilo053B	6379480	597765	ridge, 6 m high, N by S trending	PlAt	LOW		HIGH		W side of landform at Hilo053
Hilo054	6379958	597370	knoll, 0.5 m high, poorly-defined	Sb_Pl	LOW		MOD		too small for TRIM DEM
Hilo055	6380167	596833	knoll, 1 m high, poorly defined	Sb_Pl	LOW		MOD		extend TM (water) polygon - not ideal
Hilo056	6380382	596255	knoll, 1.5 m high, S end	Sb_Pl	LOW		MOD		buffer TRIM drng
Hilo057	6380513	595926	knoll, 1.5 m high	Sb_Pl	LOW		MOD		buffer TRIM drng
Hilo058	6379233	596862	slope break, edge of large	SwAt	LOW		MOD-HIGH		pattern on orthophoto may

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Location Number	Northing	Easting	Terrain Description	Forest Cover	Terrain Model Potential	Image Class. Model Potential	Observed Potential	Archaeological Site	Comment
			hill						corresp to landform
Hilo059	6377646	596881	elevated terrain NW of drng	SwSb_Pl	LOW		MOD-HIGH		buffer TRIM drng
Hilo060	6363330	596200	ridge, 50 m N by S, 1.5 m high	Pl	LOW	LOW	HIGH		buffer IC polygon - to NE within 40 m, old burn
Hilo061	6363335	596360	ridge, 50 m N by S, 0.5 m high	Pl	LOW	LOW	HIGH		too small for TRIM DEM, old burn
Hilo062	6363340	596633	ridge, N by S trending, 0.5 m high	Pl	LOW	LOW	MOD		buffer IC polygon - to NW within 25 m, old burn
Hilo063	6363313	597060	ridge, 2-3 m high, E by W trending	PlAt	LOW	HIGH	HIGH		buffer IC polygons - IC only captures portion of landform
Hilo064	6363356	597273	ridge, S end of large N by S trending	At	HIGH	HIGH	HIGH		buffer IC and TM polygons - only portions of landform captured
Hilo065	6363930	598198	ridge, 2 m high, 40 m wide, N by S trending	Pl	LOW	LOW	HIGH		buffer TRIM drng - Black Creek, old burn
Hilo066	6363926	598387	terrace ovrlook drng, 1 m high	Pl	LOW	LOW	HIGH		buffer TRIM drng - Black Creek, old burn
Hilo067	6363821	598976	slope break ovrlook drng and muskeg	Pl	LOW	HIGH	MOD-HIGH		buffer TRIM drng and IC polygon - to E within 20 m
Hilo068	6363794	599186	ridge ovrlook drng, NNW by SSE trending	Pl	HIGH	HIGH	HIGH		buffer IC and TM polygons - only portions of landform captured
Hilo069	6363910	599925	flat and featureless, muskeg	Sb	HIGH	LOW	LOW		TRIM drng buffer is too big, drng to E is ephemeral
Hilo070	6363900	600910	ridge, 50 m wide, N by S trending, poorly-defined	Pl	LOW	LOW	MOD		too poorly defined for IC and DEM
Hilo071	6363895	601565	elevated terrain surrounded by muskeg	PlSw	LOW	HIGH	MOD		buffer IC polygon to cover roads, buffer TRIM drng
Hilo072	6363877	602889	ridge, 40 m wide, N by S trending, slightly elevated	PlSw	LOW	LOW	MOD		buffer IC polygns and TRIM drng to capture portion of landform
Hilo073	6363860	604217	slope break, 0.5 m high W-aspect slope	PLSw	LOW	LOW	MOD		too small for TRIM DEM
Hilo074	6359142	595474	slope break, gentle slope	Pl	LOW		MOD-HIGH		
Hilo075	6359136	595815	slope break, 3 m above riparian setting	Pl_AtSw	LOW		HIGH		buffer TRIM drng
Hilo076	6359151	596876	ridge, 100 m N by S, poorly-defined	Pl	LOW		MOD-HIGH	HiRi-002	pattern on orthophoto may correspond to landform, old burn
Hilo077	6362001	604083	slope break ovrlook drng	SwPl	LOW		HIGH		buffer TRIM drng - Wendy Creek
Hilo078	6360748	605174	knoll, slightly-elevated, poorly-defined	SwPl	LOW		MOD		buffer TRIM drng - Wendy Creek

Appendix G – Table 1

Location Number	Northing	Easting	Terrain Description	Forest Cover	Terrain Model Potential	Image Class. Model Potential	Observed Potential	Archaeological Site	Comment
Hilo079	6358880	604917	elevated terrain - N edge, adjacent to muskeg	Pl	LOW		MOD-HIGH	HiRh-002	buffer TRIM wtlnd and drng - not ideal
Hilo080	6358635	604535	knoll, 30 wide, less than 1 m high	Pl_Sb	LOW		MOD-HIGH	HiRh-003	pattern on orthophoto may correspond to landform
HiHi-001	6075820.5	645669.15	creek terrace	Pl	HIGH		HIGH		EA notes pg 1
HiHi-002	6076784.5	645063.35	Hilltop, slope break to NE	At, Pl	HIGH		HIGH		EA notes pg 1
HiHi-003	6077314.2	643992.01	ridge adjacent to ephemeral drainage	Pl, At	HIGH		MOD-HIGH		EA notes pg 2
HiHi-004	6080943.9	644012.96	slope break, NE aspect	At, Pl	HIGH		MOD-HIGH		EA notes pg 2
HiHi-005	6081485	643061.78	slope break, NW aspect	Pl	HIGH		HIGH		
HiHi-006	6080581.5	642275.97	slope break overlooking creek	Pl	HIGH		HIGH		EA notes pg 3
HiHi-007	6080525.9	642151.61	slope break overlooking creek	Pl	HIGH		HIGH		EA notes pg 3
HiHi-008	6078560	640868.38	level terrain overlooking lake	Pl	HIGH		HIGH		EA notes pg 4
HiHi-009	6076075.6	644585.78	large ridge overlooking wetland	Pl	HIGH		HIGH	GeRe-15	EA notes pg 5
LoLo-001	6076903.7	645139.56	moderately steep slope	At, Pl	LOW		LOW		EA notes pg 5
HiHi-010	6076368	646466.45	bench overlooking creek	Pl	HIGH		HIGH		JR notes pg 2
HiHi-011	6075886.4	646600.06	terrace overlooking creek	Pl	HIGH		HIGH	GeRe-14	
HiHi-012	6076517.4	647412.66	hilltop	Pl	HIGH		MOD-HIGH		JR notes pg 3
HiHi-013	6077349.9	645883.7	small section of level slope break	Pl, At	HIGH		HIGH		JR notes pg 3
HiHi-014	6070585.9	647052.89	crest of ridge	Pl, Sf	HIGH		MOD-HIGH		EA notes pg 7
HiHi-015	6070466.4	646355.3	crest of ridge	Pl, Sf	HIGH		MOD-HIGH		EA notes pg 7
HiHi-016	6070340.6	645836.09	crest of ridge	Pl, Sf	HIGH		MOD-HIGH		EA notes pg 7
HiHi-017	6070289.6	644662.31	slope break	Pl, Sf	HIGH		MOD-HIGH		EA notes pg 7
LoLo-002	6070800.9	644267.33	steep slope	Pl, Sf	LOW		LOW		EA notes pg 7
HiHi-018	6070823.2	643851.64	level subapline saddle adjacent to ephemeral drainage	Sf	HIGH		MOD-HIGH		EA notes pg 8
HiHi-019	6070100.1	644197.25	ridge near mountain summit with good views of valley	alpine	HIGH		MOD-HIGH		EA notes pg 8
LoLo-003	6069751.3	643171.58	steep slope	Sf, Pl	LOW		LOW		
HiHi-020	6067582.1	644440.93	elevated terrain adjacent to wetland	Pl, S	HIGH		MOD-HIGH		EA notes pg 8
HiHi-021	6067980.3	644791.31	small slope breaks on moderate slope	Pl, At	HIGH		HIGH		EA notes pg 8
LoLo-004	6067676.1	644479.15	flat and featureless wetand by creek	S(b), L	LOW		LOW		EA notes pg 8

Appendix G – Table 1

Location Number	Northing	Easting	Terrain Description	Forest Cover	Terrain Model Potential	Image Class. Model Potential	Observed Potential	Archaeological Site	Comment
HiHi-022	6073711.3	624425.25	bank of Kinuseo Creek	clearing	HIGH		HIGH		
HiHi-023	6073876.7	632763.16	terrace overlooking creek	Pl, At	HIGH		HIGH	GeRf-9	
HiHi-024	6075263.1	636771.61	terrace overlooking creek	Pl, At	HIGH		HIGH		EA notes pg 10
HiHi-025	6076377	636579.78	hilltop adjacent to bend in creek	Pl, S	HIGH		MOD-HIGH		EA notes pg 10
HiHi-027	6077497.5	638060.13	level or gently sloping terrain overlooking lake	Pl, Sf	HIGH		HIGH	GeRf-5	EA notes pg 10
HiHi-026	6077371.8	637843.17	level or gently sloping terrain overlooking lake	Pl, Sf	HIGH		HIGH	GeRf-6	EA notes pg 10
HiHi-028	6374316	598421.7	bench overlooking drainage	Pl	HIGH	HIGH	HIGH		EA notes pg 13
HiHi-029	6374359	598624.1	bench overlooking drainage	Pl	HIGH	LOW	HIGH		EA notes pg 13
HiHi-030	6374822	600751.3	ridge between 2 drainages	S(b), Pl	HIGH		HIGH		EA notes pg 14
LoLo-005	6368758	604682.6	flat and featureless muskeg	S(b)	LOW	LOW	LOW		EA notes pg 15
HiHi-031	6375172	602126.7	slope break above creek	S, Pl	HIGH		MOD-HIGH		EA notes pg 15
HiHi-032	6374963	602245.8	slope break above creek	S, Pl	HIGH		MOD-HIGH		EA notes pg 15
HiHi-033	6373436	597782.3	ridge	S, Pl	HIGH	HIGH	MOD-HIGH		EA notes pg 16
HiHi-034	6379132	597927.5	5-10 m wide N-S ridge	Pl, S, At	HIGH		HIGH	HjRi-5	EA notes pg 17
HiHi-035	6379247	597849.4	5-10 m wide N-S ridge	Pl, S	HIGH		HIGH	HjRi-6	EA notes pg 17
HiHi-036	6379708	597832.2	large ridge	Pl, At	HIGH		MOD-HIGH		EA notes pg 17
LoLo-006	6380040	596541	flat, featureless, poorly-drained	S(b)	LOW		LOW		
LoLo-007	6380424	595428.5	flat, featureless, poorly-drained	S(b)	LOW		LOW		EA notes pg 18
HiHi-037	6379486	596273.8	top of large hill	S	HIGH		MOD-HIGH		EA notes pg 18
HiHi-038	6363417	597326.1	ridge	At, S	HIGH	LOW	HIGH		JR notes pg 2of5
HiHi-039	6363693	599253.6	ridge overlooking Black Creek	Pl	HIGH	HIGH	HIGH		JR notes pg 3of5
HiHi-040	6363913	599523.5	terrace overlooking Black Creek	Pl	HIGH	HIGH	HIGH		
HiHi-041	6363889	602018.5	knolls and terraces overlooking creek	Pl, S	HIGH	HIGH	HIGH	HiRh-4	JR notes pg 4of5
HiHi-042	6363880	602447.1	knolls and terraces overlooking creek	Pl, S	HIGH	HIGH	HIGH		JR notes pg 4of5
HiHi-043	6363862	603707.9	ridge overlooking creek	Pl, S(b)	HIGH	HIGH	HIGH		JR notes pg 5of5
LoLo-008	6363843	605344.3	wetland	L, S(b)	LOW	LOW	LOW		JR notes pg 5of5
LoLo-009	6358489	597798.8	flat and featureless	S	LOW		LOW		EA notes pg 20
LoLo-010	6359173	597507.1	flat and featureless	S, (Pl)	LOW		LOW		EA notes pg 20
LoLo-011	6359760	597253.1	flat and featureless	S	LOW		LOW		EA notes pg 20
LoLo-012	6363419	604052.4	flat and featureless	S(b)	LOW	HIGH	LOW		EA notes pg 20
HiHi-044	6361678	604347.4	knolls and ridges	Pl, S	HIGH		HIGH		EA notes pg 20

Appendix G – Table 1

Location Number	Northing	Easting	Terrain Description	Forest Cover	Terrain Model Potential	Image Class. Model Potential	Observed Potential	Archaeological Site	Comment
LoLo-013	6359746	606134.6	wetland	S(b), L	LOW		LOW		EA notes pg 21
LoLo-014	6359126	605266.8	muskeg	S(b)	LOW		LOW		EA notes pg 21

Appendix H

Terms of Reference

BRITISH COLUMBIA
The Best Place on Earth

Ministry of Forests
and Range

Request for Proposals

Creation of an Archaeological Overview Assessment
For the
Peace Forest District

PACKAGE CONTENTS

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  - ☒ **Specimen Contract and Schedules**

Date: July 3, 2007

File: AA08TDC001 - YR1

BC Timber Sales, Peace-Liard Business Area

9000 17 Street Dawson Creek, B.C. V1G 4A4

Contractor Instructions:

1. ***Please check to ensure that your package is complete.***
2. ***If a Receipt Confirmation Form is included in this package, please complete and return it immediately to ensure you receive any further information regarding this RFP.***

RFP NOTICE

BRITISH COLUMBIA
The Best Place on Earth

Ministry of Forests
and Range
BC Timber Sales

REQUEST FOR PROPOSALS
Peace Forest District Archaeological Overview Assessment

The ministry invites proposals from firms specializing in *Archaeology services and modelling* for an Archaeological Overview Assessment project in the Peace Forest District. The objective of the project is to *provide a reliable and accurate product which shows areas of Archaeological potential at various levels on the land base. All areas within the Peace Forest District with the exception of Parks and Protected areas and Private Land are to be covered under the Project Area. Proposals will be evaluated with preference given to contractors with archaeological experience in Northeastern BC and/ or Northern Alberta.*

A *mandatory proponent's conference call* will be held on *July 25, 2007*, at *8:30* am Pacific Standard Time (PST). Interested parties not in attendance for the entire conference call may have any subsequent submitted proposal rejected by the Ministry for this Request For Proposals process.
Proponent inquiries will not be accepted after *July 27,* 2007. Inquiries are to be directed only to the contact person identified below.
Proposals will be received not later than 1:00 PM PST on *August 2, 2007* at the address below. Late proposals will not be accepted. Proposals must be submitted in accordance with the terms and conditions specified in the information package. The lowest priced or any proposal will not necessarily be accepted. This solicitation is subject to the *BC/Alberta Trade, Investment and Labour Mobility Agreement* and Chapter 5 of the *Agreement on Internal Trade*.

Subject to satisfactory performance by the Contractor and availability of future Forest Investment Account (FIA) funding, the Parties may agree in writing to extend this agreement for a further Term of two (2) years.

To obtain further information, please contact:
Frank McAllister RPF at
frank.mcallister@gov.bc.ca Inquiries will only be accepted by email.

Sealed proposals can be sent to: BC Timber Sales, Ministry of Forests and Range – Peace-Liard Timber Sales Office at 9000 17 Street Dawson Creek, B.C. V1G 4A4

File No: AA08TDC001 - YR1

TABLE OF CONTENTS

PART A: ADMINISTRATION

1. GENERAL INFORMATION

1.1 Purpose

The purpose of this Request for Proposals (RFP) is to inform private sector businesses of a contract requirement of the Ministry of Forests and Range (the "Ministry") of the Province of British Columbia (the "Province"), and to solicit detailed proposals from interested and qualified parties ("proponents") setting out one or more means by which the stated goals, objectives and other requirements of the RFP may be best met.

1.2 Identification

This Request for Proposals includes:

- The Request for Proposals notice (the "Notice");
- Part A: Administration ("Part A");
- Part B: Requirements ("Part B");
- Part C: Attachments ("Part C").

A list of attachments is provided in the RFP Package Cover Sheet. It is the responsibility of proponents to ensure that they have all the components of the RFP package, including all attachments and subsequent addenda.

References to the RFP in the Notice, in any Part, or in any attachment are references to the RFP in its entirety.

Proponents are advised to read the RFP thoroughly and respond appropriately to the entire RFP. An incomplete proposal may be rejected.

1.3 Changes to the RFP

Changes by the Ministry to the RFP will be made in the form of written addenda or of re-issued documents which will be available at least four working days prior to the RFP closing date. All addenda shall be considered to be integral to the RFP and having the same effect as if part of the original RFP.

The Ministry will make every effort to distribute addenda to all registered or known proponents. However, it is solely the proponent's responsibility to be aware of and familiarized with any addenda or supplementary information issued.

Proponents are advised to return the RFP Receipt Confirmation Form to the Ministry, if one has been included with this RFP, to ensure that they receive any changes to the RFP.

Where the RFP has been made available electronically on BC Bid®, the Ministry may post any addendum to the RFP on the BC Bid® website at http://www.bcbid.ca. Proponents are strongly encouraged to select "Send Me Amendments" that is included as an option on the Opportunity Notice published on BC Bid®. By selecting this option a registrant will be automatically notified of any amendment that may be issued. Proponents that are not registered with BC Bid® may register by selecting *Start your e-Service, Supplier Registration* on the BC Bid® home page, www.bcbid.ca. Proponents who do not register with BC Bid® are solely responsible to continually monitor the BC Bid® website on an ongoing basis to keep themselves informed of any addendum.

1.4 Ownership Of Proposals

All proposals submitted, other than any proposal withdrawn prior to the opening of proposals or any late proposal, become the property of the Ministry and will not be returned to proponents. The successful proponent will be required under the contract to assign copyright of the proposal and of all material produced during the project to the Province.

1.5 Freedom of Information

All proposals are subject to the disclosure provisions of the *Freedom of Information and Protection of Privacy Act*.

1.6 Conflict of Interest

Prospective proponents are not eligible to submit a proposal if current or past corporate or other interests of the proponent, or of any of the proponent's subcontractors to be engaged in this project, give rise, in the sole opinion of the Ministry, to a conflict of interest in connection with this project.

Acceptance of a proposal submitted in response to this RFP will preclude the successful proponent, and any subcontractor to be engaged on this project, from participating as a proponent on subsequent project phases where, in the sole opinion of the Ministry, a conflict of interest may arise.

1.7 Proponent Responsibility

While the Ministry has made every effort to ensure an accurate representation of information in the RFP, proponents must conduct their own investigations into the material facts affecting the anticipated contract. Nothing in this RFP is intended to relieve a proponent from forming their own opinions and conclusions in respect of this RFP.

1.8 Acceptance of Terms

Proposals are submitted and accepted on the basis that proponents have read and agree to all the terms and conditions of this RFP. Proposals which include any condition or modification, or otherwise contradict any of the terms and conditions of this RFP will be as if not written and do not exist.

1.9 Form of Agreement

Included in this RFP is a pro forma, specimen contract which the successful proponent will be expected to enter into should a contract be awarded as a result of this RFP. An accepted proposal may form part of this contract.

Proponent's are cautioned to thoroughly review the specimen contract to ensure, before incurring the expense of proposal preparation, that they are capable of meeting all terms and conditions of the contract.

1.10 Funding Limitation

Notwithstanding any other provision of this RFP, the contract contemplated by this RFP and the financial obligations of the Ministry pursuant to that contract are subject to the availability of funds in accordance with the *Financial Administration Act*.

1.11 Use of Request for Proposal

Any portion of this document, or any information supplied by the Province in relation to this Request for Proposal may not be used or disclosed, for any purpose other than for the submission of proposals. Without limiting the generality of the foregoing, by submission of a proposal, the Proponent agrees to hold in confidence all information supplied by the Province in relation to this Request for Proposal.

1.12 No Lobbying

Proponents must not attempt to communicate directly or indirectly with any employee, contractor or representative of the Province, including the evaluation committee and any elected officials of the Province, or with members of the public or the media, about the project described in this RFP or otherwise in respect of the RFP, other than as expressly directed or permitted by the Province.

2. PREPARATION AND SUBMISSION

2.1 Proponent's Conference

A proponent's conference, if any, will be held at the time and in the location specified in the Notice. Proposals will not be accepted from proponents who do not attend a mandatory proponent's conference in its entirety.

At the conference, proponents may raise questions and seek clarification on any matters related to this RFP. While verbal questions will be permitted during the meeting, questions of a complex nature, or questions where a proponent requires anonymity, should be forwarded before the meeting in writing to the Ministry Contact named in the Notice. Questions which cannot be answered by the Ministry at the meeting will be responded to in writing in an attachment to the meeting minutes.

Minutes of the meeting will be prepared and forwarded to each proponent in attendance at the conference, and, if the conference attendance is not mandatory, also to those proponents who have returned the RFP Receipt Confirmation Form, if one has been included with this RFP or posted electronically on BC Bid as an amendment to the RFP Notice.

2.2 Site Viewing

There is no site viewing for this Request For Proposals. However, there is a mandatory proponents' conference call that is described in more depth within this Request for Proposals.

2.3 Inquiries

Inquiries must be directed <u>only</u> to the Contact People specified in the Notice. The Contact People have required that an inquiry be submitted in writing by email.

Inquiries and responses may be posted electronically on BC Bid as an amendment to the RFP Notice or distributed to all proponents at the Ministry's option.

Inquiries will not be received after the date and time, if any, indicated as the inquiry deadline in the RFP Notice.

2.4 Proposal Outline

All copies of the proposal must conform to the proposal outline provided in the attachment to this RFP. Failure to follow the prescribed outline may result in a reduction in evaluation points or may be cause for rejection. If alternative solutions are offered, submit the information in the same format using subheadings to identify alternatives.

2.5 Proposal Price

Proponents are solely responsible for their own expenses in preparing a proposal, including expenses related to attending the proponent's conference, the site viewing, and to conducting negotiations with the Ministry, if any.

All prices provided in the proposal shall be in Canadian dollars and shall not be increased or decreased after the submission deadline, or during or after a presentation or interview, except as provided for in section 3.10.

The Province of British Columbia does not pay the federal Goods and Services Tax (GST), therefore all proposal prices shall exclude GST.

The Province pays the provincial Social Services Tax (also known as the Provincial Sales Tax or PST) on certain goods and services. It is the proponent's responsibility to properly include the PST in the proposal price. Proposal prices are considered to be inclusive of all applicable taxes and duty.

Unless otherwise specified in Part B or C, bids on multi-year contracts are to be inclusive of inflation in future-year portions of the contract.

The proposal price shall be submitted in a separate envelope from the management and technical sections of the proposal, and in the manner specified in Parts B and C of this RFP.

2.6 Cooperating Firms / Subcontractors

Where two or more independent firms are cooperating in the submission of a proposal, the proposal shall be submitted in the name of one firm that shall be considered by the Ministry to be the prime contractor. Firms other than the prime contractor shall be identified in the proposal as subcontractors. The proposal must identify all subcontractors, their qualifications, and their respective roles in the project.

Negotiations during proposal evaluation, award and execution of the contract, and all contract payments shall be between the Ministry and the prime contractor.

2.7 Submission

Three complete hard copies of the proposal must be received at the location and before the time specified in the Notice.

Proposals must be submitted in envelopes clearly marked with the name and address of the proponent and the words, "**Proposal for Peace Forest District Archaeological Overview Assessment**" on the envelope. The proposal price should be submitted in a separate envelope marked, “Proposal Price”. All envelopes should be sealed.

Proponents are solely responsible for timely delivery of their proposals to the Ministry location specified. Late proposals will be returned unopened.

Unless otherwise provided for in Part B, proposals will not be accepted by facsimile or electronic transmission.

2.8 Revisions

Revisions to the proposal may be made prior to the Closing Date. Revisions:

- must be submitted in writing and identify the firm and the proposal being revised;
- must be in accordance with all RFP requirements;
- should be submitted in a sealed envelope to the Ministry address shown in the RFP Notice;
- if not in a sealed envelope or if submitted by facsimile or electronic transmission, any price revision should be stated in the form of an increase or decrease to the bid price by a specified value or unit, in words and figures, without disclosing the original price; and
- must be signed or electronically submitted to the Ministry Contact specified in the Notice and sent by an authorized official of the firm, preferably by the same person signing the original submission.

The proponent is solely responsible for the timely delivery of revisions. The Ministry will not accept responsibility for the lack of availability of a facsimile machine at the closing location or for systems or other problems that may affect an electronic submission.

2.9 Withdrawal

Unless specified in Part B as irrevocable, a proposal may be withdrawn by submitting a written request to withdraw to the Ministry Contact identified in the Notice. Facsimile or electronic transmission of a request to withdraw is acceptable. A proposal withdrawn after the Closing Date cannot be resubmitted.

3. EVALUATION AND AWARD

3.1 Contract Award

Depending on the proposals submitted in response to this RFP, a contract will normally be negotiated and executed with the leading proponent (the “frontrunner”) selected in accordance with the evaluation format contained in this RFP. The lowest priced or any proposal will not necessarily be accepted.

The Ministry reserves the right to:

- award portions of the project to different proponents through separate contracts;
- accept proposals in whole or in part, with or without negotiation;
- refuse award of the contract to a proponent the Ministry judges to be fully or over committed on other projects;
- refuse award of the contract to a proponent where, in the Ministry’s sole opinion, the proposal does not represent fair value;
- refuse award of the contract to a proponent where, in the Ministry’s sole opinion, the proposal price is considered too low to properly perform the contract; and
- in the case of a sole proposal being received, either:
  a) cancel the RFP, return the proposal unopened to the proponent, and re-solicit proposals for better response with or without any change being made to the RFP; or
  b) open the proposal without reference to the proponent, and, if such proposal does not merit contract award under the terms and

conditions of this RFP, cancel the RFP and re-solicit proposals with or without any change being made to the RFP.

The proponent will ensure that each member of the workforce who will perform the services in Canada under the contract is either a Canadian citizen, a permanent resident of Canada, or holds a valid employment visa from the Government of Canada.

3.2 Opening of Proposals

Envelopes containing the technical and management sections of the proposals are normally opened on or shortly after the Closing Date. To avoid the potential for price bias in the evaluation of proposals, proposal price envelopes are not opened until after the evaluation of the technical and management sections of proposals is completed, or as otherwise provided for in section 3.5.

Proposal opening and evaluation is not open to the public.

3.3 Mandatory Requirements

Proponents are cautioned to carefully read the mandatory requirements specified in the RFP and respond appropriately. A "mandatory" is an item of information that must be submitted as part of a proposal as proof of eligibility, or may apply to required attendance at a site viewing or proponent's conference. **Proposals not meeting all mandatory requirements of the RFP will be rejected without further consideration.**

3.4 Evaluation of the Technical and Management Sections of Proposals

The technical and management sections of proposals will be evaluated in accordance with the Proposal Evaluation Form attached to this RFP. Proposals must achieve the minimum evaluation points specified in the Proposal Evaluation Form in order to be placed on a shortlist for further consideration.

3.5 Presentation/Interview - Process and Evaluation

This subsection applies where a proposal presentation or interview of proponent personnel is indicated in Part B to be a part of the evaluation process.

Where, following the evaluation under section 3.4, the number of shortlisted proponents is in excess of the ministry's needs, the ministry may reduce the number of eligible proposals to not less than three by:

- opening the proposal price envelopes;
- completing a preliminary price evaluation in accordance with the method indicated in the Proposal Evaluation Form; and
- selecting, up to the number of proposals the ministry desires, the highest ranked proposals based on the preliminary price evaluation.

Proposals of those proponents who are not selected for a presentation/interview shall not be considered further in the evaluation.

The presentation/interview process shall be conducted in accordance with additional specifications provided in Part B of the RFP, if any. Presentations/interviews are for the purpose of determining proponent suitability and for expanding upon or clarifying information contained in the proposal. Presentations/interviews are not to be used by proponents as an opportunity to amend their proposals or the proposal price. Proponents may have evaluation points deducted where an attempt is made to do so.

Following a presentation or interview process, the Ministry shall evaluate the presentations/interviews in accordance with the Proposal Evaluation Form. Proposals must achieve the minimum required evaluation points specified in the form in order to remain on the shortlist for further consideration.

3.6 Clarification

Notwithstanding that a presentation/interview process has not been indicated in the Proposal Evaluation Form, at the ministry's sole discretion, one or more proponents may be asked to provide additional clarification respecting their proposals, or to address areas where the Ministry clarifies its needs.

3.7 Evaluation of Proposal Price

Prices of only those proposals on the shortlist shall be evaluated in accordance with the method indicated on the Proposal Evaluation Form. The proponent selected according to the method in use shall be the "frontrunner".

3.8 Frontrunner Notification

The frontrunner shall be notified in writing of his/her status. Where possible, verbal notification shall also be given.

3.9 Suitability of the Frontrunner

The frontrunner may be interviewed and/or the Ministry may conduct such independent reference checks or verifications as are deemed necessary by it, to clarify, test, or verify information contained in the proposal and to confirm the suitability of the frontrunner. If the frontrunner is deemed unsuitable by the Ministry, or if the proposal is found to contain errors, omissions or misrepresentations of a serious nature, the originally selected frontrunner may be rejected and another proponent selected as the frontrunner according to the evaluation format, or the Ministry may choose to terminate the RFP process and not enter into a contract with any of the proponents.

The Ministry may interview key persons to assess their scientific, technical or managerial abilities and to determine if they would be adequate for the proper performance of the proposed contract.

3.10 Negotiation with the Frontrunner

Negotiations may be held with the frontrunner including, but not limited to, matters such as:

- price, insofar as a change in price is directly associated with a change in the proposal as a result of negotiations;
- changes in technical content;
- contract details;
- contract payment details; and
- expectations of the parties applicable to the service requirements.

If a written contract cannot be negotiated within seven days of notification to the frontrunner, the Ministry may terminate negotiations with that proponent and negotiate a contract agreement with another proponent selected as the frontrunner according to the evaluation procedure, or may choose to terminate the RFP process and not enter into a contract with any of the proponents.

The Ministry shall not be obligated in any manner to any proponent whatsoever until a written contract has been duly executed relating to an approved proposal.

The Ministry reserves the right to modify the RFP at any time during the negotiation phase without notification to other proponents.

3.11 Contract Execution

Following completion of negotiations, if any, or following the notification to a frontrunner of acceptance of his/her proposal, the Ministry shall complete as appropriate the specimen contract attached to this RFP and forward the contract to the frontrunner for execution. The Ministry reserves the right to modify the contract as necessary to be commensurate with the proposal or to recognize any new matter which may have arisen since the commencement of the RFP process.

The frontrunner must complete and return the contract within the time period specified in the letter forwarding the contract for signature. Failure to do so may result in cancellation of the award.

4. SUMMARY OF CAUSES FOR REJECTION OF A PROPOSAL - PART A

A proposal **will** be rejected for the following reasons:

1. failure to attend a mandatory proponent's conference call in its entirety;
2. failure to include a specified "mandatory";
3. failure to achieve the required minimum scores in the evaluation;
4. the proposal contains errors, omissions or misrepresentations which, in the sole opinion of the Ministry, are of a serious nature;
5. the proponent is deemed unsuitable by the Ministry;
6. in the sole opinion of the Ministry, a proponent conflict of interest exists in connection with the project;
7. it is brought to the attention of the Ministry that the proponent has had substandard works that were not rectified prior to contract completion within the past three years.
8. a proposal is submitted after the Closing Date;
9. unless otherwise provided for in Part B, a proposal is submitted via facsimile or electronic transmission; or

A proposal **may** be rejected for the following reasons:

1. failure to negotiate a contract with the frontrunner within seven days of notification;
2. failure to return a duly executed contract within the time specified in the Ministry forwarding letter;
3. failure to follow the required outline;
4. the proposal is incomplete;
5. the proposal includes a condition contrary to the terms and conditions of the RFP;
6. technical/performance requirements specified in the RFP are not met;
7. the proposal specifies a pricing or a basis of payment which differs from that specified in the RFP;

PART B: REQUIREMENTS

1. *INTRODUCTION / BACKGROUND / PROJECT DESCRIPTION*

A group of stakeholders comprised of the Forest Products companies and BC Timber Sales currently operating in the Peace Forest District, the British Columbia Ministry of Forests and Range, and First Nations groups with interest in the Peace Forest District land base met in May, 2007 to discuss the current state of Archaeology modeling in the Peace Forest District. The stakeholder group agreed that the current model for Archaeological information for the Peace Forest District is in need of improvement.

The current Archaeological Overview Assessment does not appear to be comprehensive or otherwise meet the needs of the local First Nations and other stakeholder groups to adequately conserve Archaeological Resources.

The purpose of this Request For Proposals is for interested and qualified Archaeology firms to outline a methodology and process to achieve a high quality, accurate Archaeological Overview Assessment and modeling tool which will help forest managers to identify areas with varying levels of Archaeological Potential for use with operational and strategic planning activities.

The stakeholder group is aware that other modeling and archaeological based projects have taken place in the Northeast portion of British Columbia in the past. They were all in agreement that this proposal should be specific that the purpose of this Request for Proposal is to obtain a methodology and final product that will surpass the effectiveness and validity of other projects currently in place in the Dawson Creek Timber Supply and Tree Farm License 48 areas. Proposals are not to propose updating existing models. Proposals should be detailing the gathering of all available information and creating a new product which will more accurately model archaeological values on the land base.

The members of the stakeholder group also were in agreement that SUBSTANTIAL First Nations involvement in the location of sites, past use, and other relevant community information is to be an integral part of any submitted proposal. The Ministry expects that the First Nations Groups within the area be involved in the information gathering phases and input into the final deliverables. It is the responsibility of the proponent to provide a methodology as to how this will occur. Proponents are required to utilize local First Nations groups on site for field work wherever necessary. It is the responsibility of the proponent to propose how they will do this and the cost to do so in their proposal.

While considering past reports, information, communication with local First Nations groups, and models currently in place, proponents should clearly specify how the resulting product will achieve these things.

The First Nations Groups within the area are as follows:

- Halfway River First Nation
- Blueberry River First Nation
- Saulteau First Nations
- West Moberly First Nations
- McLeod Lake Indian Band
- Kelly Lake Metis Settlement Society
- Lheidli T'enneh Band

It is the responsibility of the proponent to investigate past reports, predictive models, and available digital data files for the area and consider this information when developing a methodology for this project.

2. TECHNICAL STANDARDS AND PROJECT SPECIFICATIONS:

The Archaeological Overview Assessment project must be in conformance with the following technical standard and eligibility guidelines unless a proposed variance is requested by the Proponent within the proposal.

In the event that the successful Proponent's proposal proposes to vary from these Standards, a request must be submitted to the Ministry or Ministry Representative who will then forward that request for approval of the variance. **Any proposed variance to the Standard must be clearly identified in the Proposal.**

TECHNICAL STANDARD: B.C. Archaeology Branch of the Provincial Government: ***Archaeological Impact Assessment Guidelines –October, 1998***

ONLY SECTIONS 3.4 AND APPENDIX A ARE TO BE UTILIZED FOR THE ARCHAEOLOGICAL OVERVIEW ASSESSMENT PROJECT The internet link to this standard is: http://www.tsa.gov.bc.ca/archaeology/pubs/impweb/impact.htm

Please note that the purpose of these Archaeological Overview Assessment studies is the identification and assessment of archaeological resource potential or sensitivity within a proposed study area for archaeological resources protected under Section 13 (Heritage Protection) of the Heritage Conservation Act. Section 13 of the Heritage Conservation Act states that the following types of sites may only be disturbed with a permit (this is a truncated list of types that may be encountered in the working forest):

- Burial places
- Aboriginal rock paintings or aboriginal rock carvings
- Sites that contains artifacts, features, materials or other physical evidence of human habitation or use before 1846
- Heritage aircraft wrecks

Eligible Projects

The following research components are typical of an archaeological overview assessment study and are eligible for Forest Investment Account (FIA) funding:

- Background library and records search of ethnographic, archaeological and historic documents pertinent to the study area, where the intent is to predict the location of archaeological sites protected under the Heritage Conservation Act.

- Interviews and consultation with individuals having knowledge of archaeological resources in the study areas where the objective is to compile information concerning the location, distribution and significance of reported archaeological resources.

This information is used by a qualified archaeologist to make statements (often including mapping) of the archaeological resource potential and distribution in the study area. In areas where development, resource extraction or other types of land altering is planned, further field studies by a qualified archaeologist are required to confirm the presence of protected archaeological sites.

Ineligible Projects

Studies focusing on First Nations land use, such as traditional use or cultural heritage studies, are not eligible for FIA funding as Archaeological Overview Assessment studies. These studies focus on the identification of sites significant to a local First Nations community where traditional activities take place. Information is usually gathered through interviews with knowledgeable individuals within the community and the results may be used in consultation concerning aboriginal rights and title issues. Traditional use site types may encompass spiritual sites, harvesting, hunting and other resource gathering areas, camping sites and other sites used in traditional activities of a First Nation community. Traditional use sites may or may not have an archaeological component. (i.e. use of the area may or may not leave physical evidence of habitation or use prior to 1846.) For example, a culturally modified tree site may be a traditional use site, however it is only considered an archaeological site subject to provisions of the Heritage Conservation Act if some of the cultural modifications are dated prior to 1846.
Many traditional use areas cover much larger parts of the landscape than archaeological sites defined by physical evidence.

Field work is required as part of the proposed methodology but is not to be completed for Archaeological Impact Assessment purposes. Field work must only be for the purposes of an Archaeological Overview Assessment "ground truthing" as per the above noted Standard.

Traditional Use Sites are NOT TO BE recorded or researched if the Proponent is fully confident that these sites will not provide useful input for the Archaeological Overview Assessment. This will be at the discretion of the successful proponent on a site by site basis.

3. TIMING, MAJOR MILESTONES, AND REPORTING REQUIREMENTS

- Mandatory Proponents' Conference Call: July 25, 2007 at 8:30am Pacific Standard Time.
- Deadline for Inquiries regarding the RFP: July 27, 2007 at 1:00 pm Pacific Standard Time.
- Deadline for Proposals to be submitted: August 2, 2007 AT 1:00 pm Pacific Standard Time.
- Project is to be commenced by September 15, 2007.
- The winning proponent will be required to be present in Dawson Creek at the start of the project and provide a presentation which details the proposed project methodology and to meet the First Nations groups, the Forest Products Companies, and the BC Timber Sales staff who have been involved in the creation of this project.
- Project is to be completed in its entirety by March 15, 2009.
- The successful proponent will be required to submit monthly progress reports to the Ministry or Ministry Representative.

4. REQUIRED OUTPUTS/DELIVERABLES-

Interim Deliverable for the 2007-2008 Fiscal Year End:

There must be some form of interim deliverable identified in the Proponent's proposal for March 15, 2008. This deliverable may be in the form of draft map files, or interim progress report detailing work to date.

Final Deliverables for the 2008-2009 Fiscal Year End:

Final Deliverables are to include the following:

- Signed letter by the lead Archaeologist attesting to their full adherence to the required Technical Standards and Specifications, listing of the Technical Standards and Specifications, and that the project has been completed to standard.

- 7 Hard Copies of the Final Report detailing the methodology, general findings, future recommendations, references to the mapping files, and any other item described in the Technical Standards and Specifications outlined above.
- Adobe PDF file of the Final Report.
- 7 Copies of the Hardcopy Maps at a scale of 1:50,000-with Orthophotographic base where available.
- Adobe PDF files of the Hardcopy Maps (plot files are NOT acceptable)
- Arc Info 9.0 compatible shape files and any associated database.
- Provision of all digital data obtained to be submitted to the Archaeology Branch in the required format.

Digital deliverables are to be provided on a portable hard drive. The cost for this is to be included in the Proponent's proposal.

5. MANDATORY REQUIREMENTS

- **BC FOREST SAFETY COUNCIL, SAFE COMPANIES REGISTRATION:** Proponents submitting a proposal must be registered as a BC Forest Safety Council "SAFE Company" and be able to provide proof upon request.
- **WORKSAFE BC:** Proponents submitting a proposal must clearly demonstrate their current WorkSafe BC registration is in good standing
- **PREVIOUS RELEVANT EXPERIENCE:** Proponents submitting a proposal must clearly demonstrate previous experience completing Archaeological Overview Assessment projects which combine field work, literature searches, discussions with the local communities, and computer modeling. This experience must be in at least one of the last five (5) years.
- **PROFESSIONAL AFFILIATION DEMONSTRATION:** The lead archaeologist noted in the proposal must be registered with the BC Association of Professional Consulting Archaeologists or other relevant similar Professional organization within North America.
- **DESCRIPTION OF WINNING PROPONENT PRESENTATION TO STAKEHOLDER GROUPS:** The winning proponent will be required to be present in Dawson Creek at the start of the project and provide a presentation which details the proposed project methodology and to meet the First Nations groups, the Forest Products Companies, and the BC Timber Sales staff who have been involved in the creation of this project.

6. PROPOSAL CONTENTS

To rank well in the proposal evaluation the following details must be considered and specific detail provided:

- **PREVIOUS RELEVANT EXPERIENCE REQUIREMENT:** Proponents submitting a proposal must clearly demonstrate the use of Archaeologists with prior experience in the Northeastern portion of British Columbia or Northern Alberta. All staff should have substantial prior experience in the Northeastern portion of British Columbia or Northern Alberta. Staff without this experience must be under the DIRECT supervision of an Archaeologist with this experience.
- **CLEAR OUTLINE OF PROPONENT STAFF:** All archaeologists, project management, supervisory field staff, and/ or computer staff working on the project must be clearly outlined in the proposal.
- **COMPANY COLLABORATION:** Collaboration amongst various companies is permitted, but this must be clearly outlined in the proposal and the company submitting the proposal will be the Prime Proponent.

- **CLEAR PROPOSAL METHODOLOGY:** Proposals must clearly identify in a step by step process with associated approximate timelines how the final deliverables will be achieved. The methodology must address how the final product will achieve the required results and how the project outcome will result in a deliverable superior to existing studies in the area. (discussion of existing projects in the area known to the proponent and how their methodology will address known gaps in these studies is recommended). The audience for this methodology may include people with low amounts of technical background, and thus the methodology and proposal should be clear and in terms that someone with a low amount of technical experience in the Archaeology or computer modeling field can understand.
- **COMMITMENT TO TECHNICAL STANDARDS AND SPECIFICATIONS:** Proposals must commit to adhering to the specific technical Standards and specifications noted in this proposal, unless a clear variance is requested (see next point):
- **PROPOSED VARIANCES TO THE TECHNICAL STANDARD (If any)-** If a Proposal is proposing a variance to the technical standard, the proposal must clearly identify what portions of the standard are proposed for variance, the alternative approach being proposed and a rationale as to why the variance is required.
- **ASSURANCE OF ADEQUATE FIRST NATIONS INVOLVEMENT:** Proponents should clearly describe how adequate involvement by the First Nations groups will occur. Additional points will be provided to those proponents who demonstrate a commitment to the hiring of local First Nations for the project support staff.
- **OBTAINING EXISTING DATA, INFORMATION, AND STUDIES:** Proposed methodologies must provide detailed information on how the proponent will obtain existing data and studies, involve the local First Nations' groups and consider their input for the final product, methodology and amounts of field work proposed, computer modeling methodology, and format for final deliverables.
- **QUALITY CHECKING AND QUALITY ASSURANCE:** Proposed methodologies must provide detailed information on Quality Checking and Quality Assurance of the interim deliverables, and all aspects of the work.
- **PROJECT TIMELINE AND MILESTONES:** Proposals must detail a timeline for the project and what deliverables are to be received for the March 15, 2008 deadline, and the final deliverables for the March 15, 2009 deadline.
- **REFERENCES FOR SIMILAR WORK:** References must be provided within the proposal. A minimum of three references related to similar projects is required. At least one reference should be a First Nations group.
- **DESCRIPTION OF INTERIM DELIVERABLES-**Proposals must clearly identify what is to be expected for the March 15, 2008 interim deliverable.
- **DESCRIPTION OF FINAL DELIVERABLES-**Proposals must clearly identify what is to be expected for the March 15, 2009 final deliverable.

7. MINISTRY RESPONSIBILITIES

The ministry will support the successful proponent with the ability to access to the following information:

- Orthophotographic digital files-not available for 62 map sheets in the northeastern portion of the TSA at this time, but these files may be available in May, 2008.
- TRIM contour files,
- Aerial photo contact prints (if required),
- Contact information for the Land and Resource personnel from the local First Nations groups,
- Forest Cover files,
- Private land locations in digital format.

8. AVAILABLE FUNDS

This section is not applicable for this Request for Proposal

9. CONTRACT PRICING AND PAYMENT-

The contract will be a fixed price by phase with payments to be provided to the contractor when the Ministry determines that the services by each phase have been completed to Standard.

Proposals must have a schedule of payments based on phases of work and associated timelines specified by financial quarter.

10. TRAVEL AND OTHER OUT-OF-POCKET CONTRACTOR EXPENSES

The proposal is an all found cost to complete the services outlined in the proposal.

The Ministry will provide the required hard copy photos and assist the contractor in accessing digital data from government sources where applicable. If proposals require use of hard copy photos for the project, this must be clearly outlined in the proponent's proposal as to the quantity and timeline expected for the arrival of the photos.

11. MANDATORY PROPONENTS' CONFERENCE CALL:

There will be a mandatory Proponent's conference call on July 25, 2007 at 8:30am Pacific Standard time. The purpose of this call is to provide feedback to any questions the proponents may have and to discuss the project background in more depth.

* Participant Conference Access code: 6667114 #

* Dial-in Number (604) 899 2339

Proponents should redial into the call if they are not connected to the call immediately.

Proponents not in attendance for the entire conference call may have their proposal rejected by the Ministry.

12. OTHER TERMS AND CONDITIONS

The information provided to the Proponents as part of this RFP process or subsequent contract award is often sensitive as it represents an integral part of local First Nations tradition, history, and Culture. Any distribution of or reproduction of information to a third party besides the Ministry is prohibited without the prior written consent of the Ministry.

Any Ministry provided data or items that are not returned at the end of the project will be cost calculated and deducted from the final payment to the Contractor.

It is the responsibility of the successful proponent to obtain the necessary Permits with the Archaeological Branch for this project.

PART C: ATTACHMENTS

BRITISH COLUMBIA
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Ministry of Forests and Range

Request for Proposal

PROPOSAL EVALUATION

PROJECT	CONTRACTOR IDENTIFICATION
PROJECT NAME: ______	A
PROJECT NUMBER: ______	B
CONTRACT NUMBER: ______	C
NATURE OF WORK: ______	D
LOCATED AT:	E

OPENING AND COMPLIANCE	A	B	C	D	E
• Late, Withdrawn, Unsolicited					
• Attended Mandatory Conference/Viewing					
• All Mandatories Submitted with Proposal including Safe Company, WCB, Registered Archeologist , AOA experience, Stakeholder Presentation Commitment					
ACCEPTED FOR EVALUATION (Yes/No)					

PROPOSALS OPENED AT _______A.M./P.M. ON THE _____DAY OF _______________ 20___. Attach details regarding reasons for rejecting a proposal where necessary.

WITNESSES: _________________________ _____________________________ PRESIDING OFFICIAL: _______________________________

PROPOSAL EVALUATION		ONLY SHORTLISTED PROPOSALS CONSIDERED									
		Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score
TECHNICAL	**Max Points**	A		B		C		D		E	
• RFP Objectives Met	10										
• Methodology	15										
• Scheduling	5										
• Equipment/Technology	5										
• Deliverables	5										
• Alternatives	5										
• Compatibility With Ministry Systems	0										
• Life-cycle Costs	0										
• Clarity of Proposal	10										
(1) Subtotal Points: Min = 40 Max =	**55**	---		---		---		---		---	
MANAGEMENT	**Max Points**	A		B		C		D		E	
• Proponent Experience	5										
• Proponent Stability	5										
• Project Supervision/Management	5										
• Project Personnel	10										
• Response Time	0										
• Client References	5										
• Risk Management	0										
• Use of Local First Nations for project monitors and support staff.	15										
(2) Subtotal Points: Min = 35 Max =	**45**	---		---		---		---		---	
PRESENTATION/INTERVIEW	**Max Points**	A		B		C		D		E	
• Knowledge	0										
• Ability	0										
• Suitability	0										
• Consistency with Proposal	0										
	0										
(3) Subtotal Points: Min = 0 Max =	**0**	---		---		---		---		---	
(4) GRAND TOTAL (1) + (2) + (3) **Max =**	**100**	---		---		---		---		---	

BRITISH COLUMBIA
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Ministry of Forests and Range

Request for Proposal

SHORTLISTING	A	B	C	D	E
SHORTLISTED Each subtotal point score must equal or exceed the minimum required score in line (1) (2) & (3) (Enter 'Yes' or 'No')					

PRICE EVALUATION

ONLY SHORTLISTED PROPOSALS CONSIDERED

☐ **Lowest Qualified Price:** Front-runner has lowest price in line (5) below
★ **Lowest Price Per Point:** Front-runner has lowest price per point in line (6) below

] ← ***Price Evaluation System to be Used (Check one box only)***

	A	B	C	D	E
(5) Proposal Price	$	$	$	$	$
(6) Price Per Point (5) ÷ (4)					
FRONTRUNNER (Mark with an 'X')					

RECOMMENDATIONS

SIGNATURES: ______________________________

____

____

EVALUATION TEAM CHAIRPERSON ______________________________

AWARD

PROPOSAL ____ ACCEPTED
(A,B, or C, etc.)

SIGNATURE OF AUTHORIZED EXPENSE AUTHORITY:

DATE:

BRITISH COLUMBIA
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Ministry of Forests and Range

Request for Proposal

TECHNICAL EVALUATION

Term	The award of evaluation points is based upon the degree to which the proposal:
RFP Objectives Met	1. addresses the objectives of the project stated in the RFP. 2. demonstrates an understanding of the project.
Methodology	3. methodology is suitable towards achieving the project objectives. 4. demonstrates an up-to-date approach. 5. demonstrates a level of effort (days/hours of managerial, professional & technical staff time) that is adequate to deliver what is proposed.
Scheduling	6. complies with project timing requirements stated in the RFP. 7. provides adequate allowance for problems/delays. 8. provides a realistic timetable.
Equipment/ Technology	9. demonstrates the use of up-to-date techniques and equipment.
Deliverables	10. demonstrates that the proposed product meets the ministry's requirements. 11. provides a clear report outline.
Alternatives	12. provides adequate and realistic alternatives.
Compatibility with Ministry Systems	13. provides products/solutions that fit well with existing ministry systems (computer, administrative, other).
Life-cycle Costs	14. demonstrates, if the project is a component of a larger project or a system, a minimized overall cost to the ministry.
Clarity of Proposal	15. is clear, concise, logical, and well-written.

MANAGEMENT EVALUATION

Term	The award of evaluation points is based upon the degree to which the proposal:
Proponent Experience	1. demonstrates that the firm has successfully completed similar or larger projects as stated in the RFP. 2. demonstrates that the proponent has a satisfactory previous work record with the ministry.
Proponent Stability	3. demonstrates that the proponent has been in business for a reasonable period of time. 4. demonstrates the proponent is financially stable and able to finance the carrying costs of the project. 5. demonstrates the proponent has a stable workforce.
Supervision/ Management	6. indicates that the firm will apply an adequate level of supervision to the project.
Project Personnel	7. demonstrates that the project personnel are knowledgeable in the required fields. 8. demonstrates that project personnel have experience in conducting similar projects. 9. demonstrates that project personnel have the necessary educational/professional qualifications as specified in the RFP.
Response Time	10. indicates the response time in which the services will be delivered as specified in the RFP.
Client References	11. provides client references which confirm the proponent's abilities have been demonstrated on similar projects.
Risk Management	12. minimizes legal, financial, and project risk to the ministry.
Use of First Nations staff for support staff and monitors	13. involves local First Nations in collecting of relevant archeological data including but not limited to meetings, on-site visits, and interviews.

PRESENTATION/INTERVIEW

Term	The award of evaluation points is based upon the degree to which the firm's representatives:
Knowledge	1. demonstrate that the firm collectively, and those to be employed on the project individually, have the required knowledge to deliver the project.
Ability	2. demonstrate that the firm collectively, and those to be employed on the project individually, have the required skills to deliver the project.
Suitability	3. demonstrate that the individuals to be employed on the project are personally suitable.
Consistency with Proposal	4. display a true grasp of the requirements of the RFP and how these are to be satisfied through the proposal. 5. do not attempt to introduce amendments to the proposal. (Points to be deducted where this occurs.)

MINIMUM EVALUATION POINTS REQUIREMENT

Proposals must achieve the specified minimum evaluation points in **each of** the technical, management, and presentation/interview evaluations to be considered further in the evaluation and award process. Proposals that meet or exceed **all** minimum values are classified as "shortlisted" proposals.

PRICE EVALUATION

The selection of either of the following price evaluation methods is indicated in the Price Evaluation section above.

BRITISH COLUMBIA
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Ministry of Forests
and Range

Request for Proposal

Lowest Price Per Point Method	The total evaluation points of the technical, management, and presentation/interview sections of each shortlisted proposal are divided into the proposal price to obtain a price per point. The contract is awarded to the proponent having the proposal with the lowest price per point.
Lowest Qualified Price Method	The contract is awarded to the proponent having the lowest-priced shortlisted proposal.

- If the lowest price per point method is used, and two proposals are identically scored having the same price per point, the contract will be awarded based on the lower price. If the lowest qualified price method is used, and two qualified proposals have the same low price, the contract will be awarded based on the higher evaluation score.

- If, after either of the above alternatives are exercised and both proposals are still equal, then the contract may be awarded based on further evaluation criteria as determined by the ministry.

EVALUATION "DECIMAL" SCALE

Rating		**Description**
1.0	Excellent	Exceeds the requirements of the criterion in superlative beneficial ways; very desirable.
0.9	Very Good	Exceeds the requirements of the criterion in ways that are beneficial to the ministry's needs.
0.8	Good	Exceeds the requirements of the criterion, but in a manner that is not particularly beneficial to the ministry's needs.
0.7		Fully meets all requirements of the criterion.
0.6	Average	Adequately meets most of the requirements of the criterion. May be lacking in some areas that are not critical
0.5		Barely meets most of the requirements of the criterion to a minimum level. May be lacking in some areas that are not critical.
0.4	Poor	Addresses most, but not all, of the requirements of a criterion to the minimum level. Lacking in critical areas.
0.3		Poor to very poor.
0.2	Very Poor	Minimally addresses some, but not all, of the requirements of the criterion. Lacking in critical areas.
0.1		Very Poor to unsatisfactory.
0.0	Unsatisfactory	Does not satisfy the requirements of the criterion in any manner.

MINISTRY OF FORESTS AND RANGE

REQUIRED PROPOSAL OUTLINE

Contractor Instructions:
The proposal must be prepared in accordance with the following outline. Be sure to address all the requirements of the RFP. This outline is not intended as a guide to, nor does it replace, the requirements of the RFP.

TITLE PAGE

Show the RFP name, contract or file number, submission closing date, proponent name, address, telephone number, facsimile number, email address, and the name of the proponent contact person.

LETTER OF INTRODUCTION

One page, introducing the firm and the proposal, signed by the person(s) authorized to sign on behalf of, and bind the firm to, statements made in the proposal.

TABLE OF CONTENTS (Optional where proposals are less than 20 pages.)

Show the page numbers of all major headings.

EXECUTIVE SUMMARY (Optional where proposals are less than 20 pages.)

Summarize in no more than three pages the key features of the proposal, excluding price.

TECHNICAL PROPOSAL

Indicate your understanding of the key requirements of the project and the methodology you will use in undertaking the project. Indicate timelines, milestones and products to be delivered. If subcontractors are being used, clearly indicate the role of each in the delivery of the project. **Be sure to address all the requirements and specifications contained in the RFP.**

MANAGEMENT PROPOSAL

Indicate the firm's qualifications for the project, including past projects having similar requirements to the one being bid upon. Summarize the qualifications of key staff and how these staff will be organized and supervised on the project. If subcontractors are being used, include the same information for each of them.

Be sure to include all mandatory items as required in the RFP. Failure to do so will result in the proposal receiving no further consideration.

PRICE PROPOSAL (submitted separately)

It is the practice of the ministry to evaluate the technical and management proposals without the knowledge of proponent prices. This avoids any possible perception of price-related bias in the evaluation. To make this manner of evaluation possible, submit the price proposal and bid security (if required by the RFP) in a separate envelope from the remainder of the proposal.

The price proposal shall be made in accordance with the requirements of the RFP.

ATTACHMENTS

Attach any additional information such as company brochures, a list of previous projects undertaken by the firm, personnel resumes, etc.

SPECIMEN CONTRACT AND SCHEDULES

(specimen contract to be supplied as a separate attachment to this RFP)

MINISTRY OF FORESTS AND RANGE

RFP RECEIPT CONFIRMATION FORM

(Name of Project)

Please complete this form and return IMMEDIATELY to:

NAME: ____
OFFICE: ____
ADDRESS: ____
____
____
FACSIMILE: (____) ________________________________

Contractor Instructions:

Please complete the information required below and return this form to the above address. Failure to return this form may result in no further communication regarding this RFP.

Refer to the RFP Notice to determine if a proponent's conference or a site viewing has been scheduled. Failure to attend a mandatory proponent's conference or a mandatory site viewing will result in a proponent's disqualification.

COMPANY NAME: ____
ADDRESS: ____
____
____
CONTACT PERSON: ____
TITLE: ____
PHONE NUMBER: ____
FACSIMILE NO. ____

I/we have received a copy of the above-noted RFP and: (check appropriate response)

☐ will be attending the proponent's conference call: Number of persons attending: ______

☐ will not be submitting a proposal.

SIGNATURE: ___________________________________ PRINT NAME ______________________________
TITLE: ___________________________________
DATE: ________________________